SEPTEMBER, 1941.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

1685. Experiments with radioactive Tl isotope ThC^{2-}. J. Zirkler. *Z. phys. Chem. A*, **187**, *pp.* 103–104, *Aug.*, 1940. *In German.*—Distribution tests with ThC^{2-} were made at higher temperatures between mono- and tri-valent Tl ions. The distribution coefficients are the same as Aston's isotope figures of Tl found by means of the mass spectrograph. [See Abstr. 2658 (1936)]. R. N.

1686. Covalency, ionization and resonance in C bonds. E. C. Baughan, M. G. Evans and M. Polanyi. *Trans. Faraday Soc.*, **37**, *pp.* 377–393, *Aug.*, 1941.—The properties and electrolytic dissociation of bonds between (*a*) methyl and (*b*) hydrogen, halogen and sodium are discussed in terms of the potential-energy curves of the ground and ionic states of these bonds and their resulting ionic resonance energy. By considering also the additional resonance of alkyl radicals between several canonical forms, the observed bond strengths and dipole moment of some alkyl compounds are explained. Further applications are discussed. Authors.

1687. Molecular structures of diphenylene dioxide and phenoxthin as revealed by dipole moment data. K. Higasi. *Sci. Pap. Inst. Phys. Chem. Res., Tokyo, No.* 1025, *pp.* 331–340, *May*, 1941.

1688. Determination of atomic distances and molecular structures of In and Ga halogenides by means of electron diffraction. H. Brode. *Ann. Phys., Lpz.*, **37**, 5-6, *pp.* 344–364, 1940. *In German.*—The nuclear distance in In monohalogenides, the value of which was determined by Miescher from Mecke's rule and spectroscopic data relatively to BCl, was again measured by electron diffraction. The agreement is excellent. Mecke's rule is satisfied by the In monohalogenides, while, according to Brether, in the series of Tl monohalogenides it gives too small a value for TlI. It is shown that this discrepancy depends on a strong polarization of the Tl atom, which is not to be expected for the In atom. Al, Ga, and In trihalogenides, exist in this temperature range (vapour pressure 100 mm. Hg.) mainly in the form of double molecules up to Ga iodide. The structure can best be described as a distorted octahedron made up of 2 regular tetrahedra with a common edge. The halogen atoms are at the 6 corners, the metal atoms at the centres of the 2 tetrahedra. Ga iodide is dissociated into simple GaI_3 according to vapour pressure measurements. The electron diffraction pictures are consistent with a molecular structure in which the I atoms are at the 3 corners of an equilateral triangle and the Ga atom is at the centre. M. S. V.

1689. Investigation by electron diffraction of the structures of some tetrahalides. M. W. Lister and L. E. Sutton. *Trans. Faraday Soc.*, **37**, *pp.* 393–406, *Aug.*, 1941.—The structures of a number of tetrahalides have been determined from the scattering of fast electrons by their vapours. In every case where the configuration would have an important effect upon the mode of scattering it was found that the assumption of a tetrahedral molecule was entirely satisfactory. These measurements provide a number of further examples of bonds which are shorter than the sums of the covalent radii ascribed by Pauling and Huggins. Authors.

1690. Investigation by electron diffraction of some dihalides of Cd, Sn and Pb. M. W. Lister and L. E. Sutton. *Trans. Faraday Soc.*, **37**, *pp.* 406–419, *Aug.*, 1941.—The structures of the chlorides, bromides and iodides of Cd and of divalent Sn and Pb were examined by the electron diffraction method. It is shown that the Cd halides are probably linear molecules while the others certainly are not. Authors.

1691. Kinetics of degradation and size distribution of long-chain polymers. R. Simha. *J. Appl. Phys.*, **12**, *pp.* 569–578, *July*, 1941.

See also Abstracts 1700, 1747.

COLLOIDS.

1692. The rheology of clay. H. H. Macey. *J. Sci. Instrum.*, **18**, *pp.* 159–165, *Aug.*, 1941.—The rheology of clay/water mixtures, both liquid and solid, is critically reviewed. Certain discrepancies between different experimental and mathematical treatments of the liquid suspensions are pointed out. The probable structure of the solid mixtures and their exceptional properties are discussed and it is shown how these properties may be explained by the supposition that the surfaces of the clay particles repel one another, and thereby appear to be separated by water films. Author.

1693. Electron microscope study of curd fibres of sodium laurate. L. Marton, J. W. McBain

AND R. D. VOLD. *J. Amer. Chem. Soc.*, **63**, *pp.* 1990–1993, *July*, 1941.—Electron microscope photographs of a curd of sodium laurate show that it consists of a mass of fibres which are thin ribbons whose widths tend to be integral multiples of approx. twice the length of the sodium laurate molecules. The fibres branch to form a felt, which accounts for the rigidity of the curd. The fibre junctions also give rise to many capillary spaces of variable dia. in which water can be retained, even at very low rel. humidity. Some of the sodium laurate is not part of the fibrous structure but is present as granules 100–200 Å in dia., irregularly spaced along the fibre. AUTHORS.

1694. Effect of formaldehyde on the iso-electric points of some proteins, determined by microelectrophoresis. S. J. CIRCLE AND A. K. SMITH. *J. Phys. Chem.*, **45**, *pp.* 916–930, *June*, 1941.—Observations were made on protein-coated microscopic quartz particles suspended in aqueous acetate buffers of ionic strength 0·01, and the *p*H of the iso-electric point of the protein was obtained from a mobility/*p*H graph. The iso-electric points of all the proteins studied were lowered 0·1 to 0·7 *p*H unit by the action of formaldehyde, except for soybean meal, which was unaffected by 5% or 10% formaldehyde. The concentration of formaldehyde and the time of reaction were small but positive factors in the shift of the iso-electric points to lower values for all but 2 of the proteins studied. New data are presented for the iso-electric points of soybean protein samples prepared by several methods. AUTHORS.

See also Abstract 1902.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

1695. Temperature diffuse scattering of a simple cubic lattice. W. H. ZACHARIASEN. *Phys. Rev.*, **59**, *pp.* 860–866, *June* 1, 1941.—The rigorous calculation of the temperature diffuse scattering pattern of a crystal presupposes a knowledge of the propagation velocities and of the polarization directions. It is shown how these quantities can be found for a simple cubic lattice of the Born-Kármán type. When the elastic constants satisfy the condition $c_{11} = 3c_{12}$ the formula for the intensity distribution in the diffraction max. is particularly simple and this case is therefore treated in some detail. Expressions for the positions and half-widths of the intensity max. have been developed, and the case $c_{11} \gg 3c_{12}$ has received special attention. For lattices of this type the diffuse diffraction max. have a complex structure, each max. consisting in the general case of three peaks, of which only 1 or 2 will be observable under proper conditions. According to theory there is no diffuse halo around the forward beam. Such a halo has been reported by some experimenters, and it is suggested that the observed diffuse ring is not connected with the temperature diffuse scattering but is due to continuous radiation in the incident beam and scattering from the air. AUTHOR.

1696. New technique for preparing monocrystalline metal surfaces for work function study. The work function of Ag(100). P. A. ANDERSON. *Phys. Rev.*, **59**, *pp.* 1034–1041, *June* 15, 1941.—The method utilizes the results of recent electron diffraction studies which show that many cubic-lattice metals, when thermally vaporized and condensed on heated cleavages of rocksalt, form films which are in effect single crystals with a (100) plane parallel to NaCl (100). With silver as a typical metal of this class a technique has been developed of preparing an Ag (rocksalt) film in the measuring tube itself and of then determining its contact difference of potential against (1) polycrystalline Ag films deposited on glass at room temperature, and (2) a reference metal of known work function, Ba. The Ag was fractionally distilled and only the middle fractions deposited on the glass and rocksalt targets, the Ba fractionally and multiply distilled and its discarded fractions used to getter the tubes in which the measurements were made. The contact p.d. between Ag (rocksalt) and Ag (glass) has been found to range from 0·12 V in a preliminary measurement to 0·32 ± 0·03 V in final measurements made after the technique of preparing the Ag (rocksalt) films had been perfected. The contact p.d. for Ag (glass)-Ba is found to be 1·95 V, in close agreement with earlier results at liquid-air temperature. Work function values computed from these measurements and the work function of Ba, 2·52 eV, are 4·47 eV for Ag (glass) and 4·79 eV for Ag (rocksalt). Since two independent electron diffraction investigations, both especially complete for Ag, indicate that Ag (rocksalt) films formed under the conditions of the present experiments invariably approximate closely to the ideal (100) structure, and since the contact potential method measures the average work function of a surface without weighting vestigial regions of imperfect symmetry, the Ag (rocksalt) work function value is identified tentatively with the work function of Ag (100). AUTHOR.

1697. Introduction of chemically defined additions into alkali-halide crystals. S. AKPINAR. *Ann. Phys., Lpz.*, **37**, 5-6 *pp.* 429–441, 1940. *In German.*—The author introduces anions into the alkali halides by adding alkali salts to the melt. The crystals are grown in air or N atmosphere, using the Kyropoulos method, or *in vacuo* by slow cooling. Typical absorption spectra are observed

and co-ordinated to special products by studying the reaction with a second substance diffusing into the crystal. A number of absorption curves are given and their changes under the influence of chemical attack and electric fields are discussed. The introduction of S into alkali-halide crystals by the addition of alkali sulphide or from a sulphur atmosphere above the melt produces absorption bands in the visible which are not photosensitive. But interesting phenomena like luminescence in KCl + S and motion of colour centres toward the cathode in KJ + S are reported.
A. VON H.

1698. Optical excitation of colour centres. A. SMEKAL. *Ann. Phys., Lpz.*, **38**, 5, *pp.* 340–344, 1940. *In German.*—A brief résumé of the author's conclusions concerning the origin of colour centres in alkali halide crystals. M. S. V.

1699. Investigations on pure Cr in the anomalous region. (Electrical and thermal resistance, thermoelectric force, sp. ht., magnetic susceptibility and lattice structure). H. SÖCHTIG. *Ann. Phys., Lpz.*, **38**, 2, *pp.* 97–120, 1940. *In German.*—The electrical resistance of 3 different pure Cr samples was measured and the anomaly discovered by Bridgman (min. resistance in the vicinity of room temperature) was confirmed. The thermo-electric force shows a similar behaviour. On the other hand the anomaly of the thermal conductivity could not be clearly detected. For the purest specimen at 0°C. the resistivity is $2{\cdot}11 \times 10^{-5}$ Ω/cm. cube, the thermo-electric force with respect to constantan $+ 511 \times 10^{-7}$ V/deg., the thermal conductivity 0·292 W/cm. cube deg. From the behaviour of cooling curves it is inferred that there is no transformation within a narrow temperature range connected with heat capacity. The susceptibility is almost independent of temperature and is $X_{\infty} = 3{\cdot}49 \times 10^{-6}$ at 16°C. Debye-Scherrer patterns taken at several temperatures show that the anomalous behaviour of Cr cannot be accounted for by a change in the lattice structure. The lattice constant of the space-centred cube was found to be 2·85 Å. The anomaly seems to be tied up with the particular electron configuration of the Cr atom. M. S. V.

DIFFUSION AND OSMOSIS.

1700. Theory of the thermal diffusion coefficient for isotopes. II. R. C. JONES. *Phys. Rev.*, **59**, *pp.* 1019–1033, *June* 15, 1941.—The treatment given previously [Abstr. 2737 (1940)] was subject to the restriction that the depth ϵ of the potential energy min. must be small compared with kT. The present treatment of the 9,5 model is valid to all orders of ϵ/kT. The results indicate that the thermal diffusion constant first increases slightly as the temperature decreases, and then decreases rapidly, passing through zero and becoming negative at a temperature about 1·5 times the critical temperature. The constant becomes strongly negative as the temperature decreases still further and then approaches zero as the abs. temperature approaches zero. When the theoretical results are modified to account for the fact that the Ne molecule is much harder than is indicated by a repulsive force index of 9, a quantitative agreement is obtained with Nier's experimental data on mixtures of the Ne isotopes. An approx. method is presented which permits one to obtain, from the results for the inverse power model, the first 2 terms of the series development of α in powers of ϵ/kT for the general Lennard-Jones model of intermolecular forces. AUTHOR.

1701. Diffusion of electrolytes and of the ions in their mixtures. J. R. VINOGRAD AND J. W. MCBAIN. *J. Amer. Chem. Soc.*, **63**, *pp.* 2008–2015, *July*, 1941.—Developing the classical relations of Nernst and Arrhenius, equations are given for calculating diffusion of ions with, through or against, other ions. Effects due to mere concentration gradient are explicitly kept separate from the electrical factor produced by diffusion potential. Only when the latter is zero do ions move at their true intrinsic velocity. In other mixtures fast irons are accelerated and slow irons are retarded and may be almost completely stopped. AUTHORS.

ELASTICITY AND PLASTICITY.

1702. Equi-areal pattern of stress trajectories in plane plastic strain. M. A. SADOWSKY. *J. Appl. Mech.*, **8**, *pp.* 74–76, *June*, 1941.—The equi-areal property of stress trajectories as derived in the paper can be readily used to evaluate photographs of slip lines in plasticity with a higher degree of accuracy and reliability than hitherto. The analytical method can be applied to the equi-areal pattern formed by stress trajectories, and formulae for stresses are obtained. An example referring to radial flow adequately illustrates the general equi-areal property. AUTHOR.

1703. Determination of the shearing stresses in axially symmetrical shafts under torsion by finite-difference methods. S. T. NEWING. *Phil. Mag.*, **32**, *pp.* 33–49, *July*, 1941.—Finite-difference methods are applied to find numerical solutions of differential equations in problems not amenable to exact formal analysis. Methods of this kind were used by Richardson [Abstr. 894 (1910)]. The method is applied to 3 problems relating to the torsion of symmetrical shafts of different types, and the resultant shear stresses are determined for hollow shafts of varying section. G. E. A.

1704. Efficient vibration-free suspension for sensitive fluid mirrors. H. E. R. Becker. *Z. techn. Phys.*, **21**, 9, *p.* 195, 1940. *In German.*—In general 2 requirements must be satisfied by a suspension to insulate effectively against vibration: (1) the natural period of all modes of vibration of the suspension itself must be long compared with that of the disturbing vibrations and (2) all degrees of freedom must be damped. By suspending the platform on which the mercury mirror rests by 3 rubber bands (25 cm. elongation) the first requirement is satisfied, since building shocks are in general of relatively high frequency. The second condition for vertical vibration is provided by the internal damping of the rubber bands themselves. The second condition for the horizontal translational degrees of freedom and the rotational degrees of freedom is provided by a damped auxiliary pendulum suspended from the platform itself. This pendulum is suspended from a universal pivot located off the vertical axis of the platform and has 2 perpendicular damping arms that dip into containers of oil. An analysis shows that the pendulum damping should be large compared with the damping of the suspension without the pendulum. Under these conditions rotational as well as translational vibrations are quickly damped out. G. H. D.

See also Abstracts 1796, 1928.

GRAVITATION.

1705. Gravity meters. J. M. Bruckshaw. *Proc. Phys. Soc., Lond.*, **53**, *pp.* 449–465; *Disc.*, 465–467, *July*, 1941.—An account is given of various static gravity meters, including the Threlfall & Pollock quartz-thread balance, the Hartley, the Boliden, the Gulf and the Haalck gravity meters, all of which are direct instruments with arrangement for some magnification. Other instruments which operate near a position of instability in order to get the necessary sensitivity are described and include the Thyssen and the Ising and Urelius gravity meter and the Holweck-Lejay inverted pendulum. A. W.

HYDRODYNAMICS AND AERODYNAMICS.

1706. Theory of plane perturbations in frictionless gases. II. K. Bechert. *Ann. Phys., Lpz.*, **38**, 1, *pp.* 1–25, 1940. *In German.*—This continuation of previous work [Abstr. 2004 (1940)] contains the general integration of the differential equations of 1-dimensional perturbations in frictionless gases and liquids for polytropic changes of state with arbitrary index n ($n \neq 1$) from which x and t as functions of density and fluid velocity are calculated. The case $n = -1$ (liquids) is considered in particular, together with the corresponding boundary-value problem. The paper closes with a discussion of standing waves between fixed walls, for the case where $(3 - n)/2(n - 1)$ is an integer, and the corresponding location of the nodes. M. S. V.

1707. Subsonic flow of a compressible fluid past a symmetrical Joukowski aerofoil. S. Tomotika and H. Umemoto. *Rep. Aero. Res. Inst. Tokyo*, *No.* 205, *pp.* 35–125, *March*, 1941.—Poggi's method is used to investigate the 2-dimensional irrotational subsonic flow of a compressible fluid past a symmetrical Joukowski aerofoil placed at an arbitrary inclination to the direction of the undisturbed stream. The critical Mach number is calculated as a function of the angle of attack and the thickness ratio of the aerofoil, taking air as the fluid. For any angle of attack, other than 0°, the curve of the critical Mach number against the thickness ratio, t, has a max. at a definite value of t. The lift on the aerofoil is calculated and the effect of the compressibility of the air upon it obtained. A. J. M.

1708. Flow of a compressible fluid past a circular cylinder. II. I. Imai. *Proc. Phys.-Math. Soc., Japan*, **23**, *pp.* 180–193, *March*, 1941.—In continuation of previous work [Abstr. 4325 (1938)] the irrotational flow of compressible fluid past a circular cylinder is studied mathematically by the Janzen-Rayleigh method to the third order of approximation; an expression is derived for the velocity potential correct to M^6 (M denoting the Mach number $= U/C_0$). Expressions are also derived for the velocity distributions on the surface of the cylinder and on the radial line normal to the direction of the undisturbed flow. The results are compared with Taylor's experimental results; improved agreement is obtained. The true value of M for air is found to be 0·4. The Prandtl-Glauert linear theory and Tsien's hodograph method are discussed, and an asymptotic expression is derived for the velocity potential at a great distance from a cylinder of arbitrary cross section, for the case of zero circulation. J. S. G. T.

1709. Characteristics of fire jets. J. S. Blair. *J. Instn Civ. Engrs*, **16**, *pp.* 354–380, *June*, 1941.—Tests have been made on water jets from hoses to determine the height and horizontal throw of jets issuing at various angles, the efficiency and loss of pressure in lengths of hose, and the characteristics of various types of hose. It was found that the discharge under a pressure P lb./in.^{2} may be calculated from the formula $G = 24{\cdot}7E_d d^2 + P$, where G is the discharge in gal./min., E_d the discharge efficiency, which ranges between 96% and 100% for sizes from ½ to 1 in., and d is the jet dia. in in. For unlined canvas hose of 2 to 3 in. dia.

the pressure loss is given by $p = G^{1.85}/4{\cdot}33d^5$, where p is the pressure drop in lb./in.^{2}/100 ft. of hose. Thin rubber-lined hose gave drops approx. 60% of that for unlined canvas hose, and thick rubber-lined hose about 45% of that value. The height attained by the water increased with the water pressure at the nozzle for the range 0–120 lb./in.^{2} and increased with increase of the nozzle dia. The ratio of the max. height attained to the theoretical max. decreased with increase of pressure from 100% at 0 lb./in.^{2} to 58% for a 1 in. nozzle and 30% for a ½ in. nozzle at 120 lb./in.^{2} The trajectory of the water jet departed from parabolic and hence the angle for max. throw was found to be 25° for pressures up to 60 lb./in.^{2} and decreased to only 12° for pressures up to 140 lb./in.^{2} Curves are given for height and throw and examples are given illustrating their practical applications. A. C. W.

***1710. The Annis meter.** H. B. MacNeille and R. K. Annis. *Mech. Engng, N.Y.*, **63**, *pp.* 281–285, *April*, 1941. *Engineering*, **151**, *pp.* 478–480, *June* 13, 1941.—This meter is an application of the Venturi principle to the conical intake tube of a pump. The narrow portion is pierced by a ring of piezometer holes, and to this ring one arm of a manometer is attached. The other arm is submerged in the supply channel and acts as a balance-tube. The accuracy is at least equal to that of a Venturi meter. W. A. R.

KINETIC THEORY OF MATTER.

1711. Measurement of velocity distribution functions. P. Vetterlein. *Ann. Phys., Lpz.*, **37**, 8, *pp.* 583–588, 1940. *In German.*—A method is described for rapid measurement of velocity distribution curves of gas molecules. Curves are exhibited for Hg and Cs vapour. M. S. V.

1712. Polarizability of the H atom. H. Scheffers. *Phys. Z.*, **41**, *p.* 399, 1940. *In German.*—Referring to previous work [Abstr. 2543 (1936)] it is assumed that the edges of the 0·04 mm. glass slit used had a catalytic effect on the atom stream passing through it in forming molecular hydrogen, with consequent evolution of heat and rise in temperature of the slit. This reaction is particularly strong on metal surfaces, making a direct thermocouple measurement of the beam temperature impossible. By making the slit out of Osram M-glass a brownish discolouration was noted on its edges after several hours' running. Heating this glass with an enclosed thermocouple element in a H flame produced the same discolouration at about 500°C. and softening shortly after. This temperature cannot be ascribed to the atomic beam, because behind the slit (pressure = 0·2 mm.) the atoms have a m.f.p. larger than its width. Assuming a value of 600° ± 100°K. for the beam, the earlier value of α must be increased to $(6 \pm 2) \times 10^{-25}$ cm.^{3} which substantiates the wave-mechanical view of the H atom as against the Bohr model. W. W. W.

LENGTH, AREA AND VOLUME.

***1713. Improved spherometer.** J. L. Houghton. *Commun. No.* 809 *H, Kodak Res. Lab. J. Sci. Instrum.*, **18**, *pp.* 167–168, *Aug.*, 1941.—A spherometer is described which is fitted with a device for indicating the point of contact. A plunger passes up the centre of the screw and, on making contact with the surface to be measured, rises relatively to the screw. The upper part of the plunger carries a small glass disc which, when it rises, touches a convex glass surface fixed to the screw and so produces Newton's rings. The spherometer can be used for measuring finely ground or opaque surfaces. Author.

***1714. Pipette for delivery of small quantities of gas.** W. J. H. Moll and H. C. Burger. *Z. techn. Phys.*, **21**, 9, *p.* 203, 1940. *In German.*—Two vessels are connected by a vacuum stopcock, the stopper of which is not bored through as usual but provided on one side with a small closed canal. One of the vessels is evacuated, the other contains gas to be delivered ; a stepwise increase of pressure in the evacuated vessel is produced by turning the stopcock as many times as may be desired. A calibration may be made by McLeod gauge. G. H. D.

MASS.

***1715. Scales. General survey.** Schlee. *Arch. techn. Messen, No.* 105, *J*131–3, *March*, 1940. *In German.*—General requirements, definitions and physical principles, are dealt with and descriptions of the more important representatives of the following types are given : lever, switch-weight, sliding-weight, inclination, spring and hydraulic-pressure scales. The inclination scales have experienced an exceptional development during the last 2 decades, in the application to full or half automatic rapid precision weighing. R. N.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

1716. The fractional dimensional theory of continued fractions. I. J. Good. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 199–228, *July*, 1941.

1717. Generalized helices of Hayden and Syptàk in an *N*-space. Yung-Chow Wong. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 229–243, *July*, 1941.

1718. Probability distribution of the extent of a random chain. H. E. Daniels. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 244–251, *July*, 1941.

1719. Normal law of frequency for vector quantities. M. Masuyama. *Proc. Phys.-Math. Soc., Japan*, **23**, *pp.* 196–199, *March*, 1941.—The author shows that the normal law of frequency for a vector variable is completely determined by the variance tensor of this set. Author.

1720. Characteristic values of the correlation tensor and a new measure of correlation between vector quantities. M. Masuyama. *Proc. Phys.-Math. Soc., Japan*, **23**, *pp.* 199–204, *March*, 1941. —It is shown that none of the characteristic values of the correlation tensor are negative. Utilizing this fact, the author proposes the trace of the correlation tensor divided by n as a measure of correlation between n-dimensional vector sets. Author.

1721. Standard error of the mean vector. M. Masuyama. *Proc. Phys.-Math. Soc., Japan*, **23**, *pp.* 194–195, *March*, 1941.

1722. Totally ortho-normalized vector set and the normal form of correlation tensor. M. Masuyama. *Proc. Phys.-Math. Soc., Japan*, **23**, *pp.* 346–351, *April*, 1941.

1723. Mean angle between 2 vector sets. M. Masuyama. *Proc. Phys.-Math. Soc., Japan*, **23**, *pp.* 351–355, *April*, 1941.

***1724. Calculating machines. Adding machines. Sprocketwheel machines.** F. A. Willers. *Arch. techn. Messen, No.* 103, *J*081–1, *Jan., and No.* 105, *J*081–2, *March*, 1940. *In German.*—A survey of adding machines with and without automatic decimal switching, including those permitting of multiplying and dividing by repeated addition or subtraction, respectively. The general design of the counting gear, printing gear, extinguishing mechanism and decimal switching, is described and illustrated. One-step and 2-step mechanisms are discussed, as well as machines with a full and a decimal set of keys. Machines working on the Hollcrith punched-card principle are also dealt with. R. N.

MECHANICS, CLASSICAL.

1725. Stresses in, and deflection of, circular flat plates with a central hole, under normal forces. S. Labrow. *Proc. Instn Mech. Engrs, Lond.*, **145**, *pp.* 115–125, *June*, 1941.—The author has applied a general method, due to Kerr, to calculate the stresses and deflections in circular flat plates. The general method is first outlined, in which similarity of form is secured between 2 groups of equations applicable to materials subjected to normal and radial forces and with a non-uniform temperature distribution ; 12 variations of the case given are investigated, with different edge conditions and different loading. The results of the analysis are presented in tables and curves. G. E. A.

1726. Analysis of spoked rings. L. H. Donnell, H. B. Gibbons and E. L. Shaw. *J. Appl. Mech.*, **8**, *pp.* 67–73, *June*, 1941.

1727. Dynamics of cell constriction during division. N. Rashevsky. *Bull. Math. Biophysics*, **3**, *pp.* 57–62, *June*, 1941.—The approx. equation is derived for the rate of constriction of a dividing cell, describing the phenomenon from its early stages. The equation previously derived by Young for the case when the constriction has already considerably progressed is obtained as a limiting case. Author.

MECHANICS, QUANTUM.

1728. Synthesis of wave and point mechanics. W. Wessel. *Ann. Phys., Lpz.*, **38**, 4, *pp.* 261–271, 1940. *In German.*—Planck [Abstr. 2332 (1940)] has recently discussed the question of how the passage from wave to point mechanics in the limit $h \rightarrow 0$ is to be rigorously formulated. The usual way to relate the wave to the action function by $\Psi = e^{iw/h}$ and in the equation for w, $w \pm \frac{1}{2}(\nabla w)^2 + u - \frac{1}{2}ih\nabla^2 w = 0$, to delete the term in h is turned down by Planck on the grounds that, because of the dependence of w on h the term $h\nabla^2 w$ is frequently of the same order as $(\nabla w)^2$. Wave mechanics should be so modified when the ratio $ih\nabla^2 w/(\nabla w)^2$ vanishes everywhere as $h \rightarrow 0$. The author points out that this is in fact achieved in Born's interpretation of wave mechanics. Planck's analysis, however, gives an excellent insight into the boundary region between wave and corpuscular mechanics. M. S. V.

1729. Attempt at a synthesis of wave and corpuscular mechanics (addendum). M. Planck. *Ann. Phys., Lpz.*, **38**, 4, *pp.* 272–273, 1940. *In German.*—Referring to Wessel's paper the author points out that it does not seem self-evident that the condition $\Psi\nabla.(\nabla\Psi)/|\nabla\Psi|^2 \rightarrow 1$ can be satisfied for every mechanical system. M. S. V.

1730. Artificial boundary conditions in wave mechanics : the restricted rotator. A. Sommerfeld and H. Hartmann. *Ann. Phys., Lpz.*, **37**, 5–6, *pp.* 333–343, 1940. *In German.*—Determination of the proper functions and proper values for the artificial boundary conditions $\theta = \theta_0$ of the "restricted" rotator. The limiting case $\theta \rightarrow \pi$. Rigorous treatment of this case by hypergeometric functions. M. S. V.

1731. Theory of liquid He II. Hsien-Yü Hsü and W. Band. *Phys. Rev.*, **59**, *pp.* 1013–1018, *June* 15, 1941.—It is assumed that atoms in the surface of a liquid can be in energy states appropriate to a 2-dimensional monolayer, determined wave-mechanically from the area and shape of the surface. It is proved that in Bose-Einstein statistics there exists a tendency for atoms to pass over into such states in preference to the 3-dimensional states normally occupied, when the temperature reduces to the Einstein λ-point given by T_0 where $nh^3(2\pi mkT_0)^{-3/2} = 2{\cdot}612$, n being the number of atoms per unit volume. It is supposed that, if a single monolayer has almost completely passed over into the 2-dimensional states, a new surface at once presents itself, accessible to the formation of another monolayer. In this case the change-over from 3-dimensional to 2-dimensional states can pass almost to completion, so that at temperatures sufficiently below T_0 nearly the entire liquid is arranged in concentric shells which contain atoms in mutually independent sets of 2-dimensional energy states. Two parameters appear in the analysis : the proportion of the space actually occupied at any stage of the transition by monolayers which is also accessible to atoms in the 3-dimensional states, and the relative numerical density per cm.^{2} of atoms in a monolayer. By reasonable choices of these parameters a good fit is obtained with the shape of the experimental sp. ht. curve plotted against (T/T_0), although the theory still predicts too high a value for T_0, namely 3·09°K. The theory explains the thermo-mechanical or fountain effect and suggests a reasonable interpretation of the surface transfer phenomena. AUTHORS.

1732. **Species classification and rotational energy-level patterns of non-linear triatomic molecules.** R. S. MULLIKEN. *Phys. Rev.*, **59**, *pp.* 873–889, *June*, 1941.—The quantized energy-levels of symmetrical and asymmetrical tops are discussed from the point of view of their classification into species defined by symmetry operations, and simple species nomenclatures are proposed. These are then applied in a discussion of the rotational levels of symmetrical non-linear triatomic molecules AB_2. With SO_2 as an example, the pattern of rotational levels is studied as a function of the apex angle 2α (near-prolate-symmetrical case for large α, oblate or near-oblate case for intermediate α, second near-prolate case for small α). The classification of the overall wave functions with respect to behaviour for exchange of equal nuclei and for inversion is then considered. This gives rise to level patterns like those of diatomic and linear molecules in the first near-prolate case, but of interesting unfamiliar types in the oblate case, and of relatively unfamiliar types in the second near-prolate case. Rotational-vibrational and rotational-electronic perturbations are discussed in relation to the species classifications. The concept of gyrovibronic species, and a corresponding nomenclature, are introduced. Tables are given, for the case of symmetry C_{2v}, showing what types of transitions are allowed by the vibronic selection rules for every type of electronic transition, allowed or forbidden. Finally, non-linear ABC molecules are considered. AUTHOR.

1733. **Measurement of observables in relativistic quantum mechanics.** O. HALPERN AND M. H. JOHNSON. *Phys. Rev.*, **59**, *pp.* 896–901, *June*, 1941.—The paper discusses the question how far observables in quantum theory can be accurately measured if no assumptions are made about the values of conjugate variables. The physical connection between the uncertainty principle and the commutation relations is briefly discussed. A treatment of the γ-ray microscope makes it appear that even with small-angle diffraction no great improvement beyond the Compton wavelength can be obtained. An analysis of an ideal arrangement for measuring electric field strengths leads to the result that, admitting the existence of arbitrarily constituted test bodies, the accuracy of the measurement still cannot exceed certain limits which are mainly defined by the wavelength of the field and the spatial and temporal domain of measurement. These restrictions are due to the properties of the "vacuum," which are changed as a consequence of the possibility of pair production. AUTHORS.

See also Abstract 1686.

PRESSURE.

*1734. **Thermo-electric vacuum meter.** W. J. H. MOLL AND H. C. BURGER. *Z. techn. Phys.*, **21**, 9, *p.* 199, 1940. *In German.*—It is possible to change the pressure range through which a thermocouple vacuum meter works by the use of differently sized elements. For example, short, heavy elements will shift the working range to higher pressures while long, thin elements are useful at l.p. A pressure meter is described which, by using thermocouples of various sizes, has a useful range from 10^{-3} mm. of Hg to 10 mm. Hg pressure. The 2 pressure-sensitive units, each formed of a long, thin thermocouple element in series with a short, thick one, form 2 arms of a Wheatstone bridge and are so connected that the thermal e.m.f.'s are in opposite directions. The other 2 arms of the Wheatstone bridge consist of resistance boxes. The bridge current also serves as the source of heat for the thermocouples. The bridge is balanced with a high vacuum ($p < 10^{-4}$) in the bulb containing the pressure-sensitive elements. As the pressure increases, the thermal e.m.f.'s change with the thermocouple temperatures and unbalance the bridge. Since the balance of the bridge is unaffected by the direction of the heating current, a.c. may be used. The range of a thermocouple meter may be extended up to a pressure of 1 atm. by attaching the heater wire to the thermocouple at some distance from the junction itself. If the junction is placed above the heater wire, air convection will cause a temperature rise of the junction which depends upon the heat convection current and therefore upon the gas pressure. G. H. D.

*1735. **Pressure-regulating apparatus for vacuum systems.** F. M. LEWIS. *Industr. Engng Chem.* (*Analytical Edition*), **13,** *p.* 418, *June* 16, 1941.

*1736. **Materials for slack diaphragms.** T. PUSCHMANN. *Forsch. IngWes.*, **11,** *pp.* 35–42, *Jan.–Feb.*, 1940. *In German.*—After indicating the conditions to be met by slack diaphragms the author discusses specially devised measuring methods for testing the materials most generally used. The methods refer especially to the measurement of the stroke, the elasticity and density, of the unloaded and loaded diaphragm and to an air-conditioned chamber for imitating various climatic conditions. Special investigations deal with the shifting of the zero point of the diaphragm. Simili leather (American fish skin) impregnated with castor oil showed the best properties for diaphragm work. Test methods simplified for practical purposes are also discussed. R. N.

RELATIVITY AND ETHER.

1737. **Experimental study of the rate of a moving atomic clock. II.** H. E. IVES AND G. R. STILWELL. *J. Opt. Soc. Amer.*, **31,** *pp.* 369–374, *May,* 1941.—Criticisms have been made of the author's contention [Abstr. 3541 (1938)] that the frequency of a moving radiating source is altered by the factor $(1 - v^2/c^2)^{\frac{1}{2}}$. This is based on experiments with high-speed hydrogen canal rays. An experimental device for doubling the speed used is described, and this confirms the previous result. The effect on the reference line was also tested and gives rise to no errors. The effect of observing the approaching particles directly and the receding ones by reflection is also shown not to vitiate the result. G. C. McV.

1738. **Dynamics of a particle in general relativity.** C. LANCZOS. *Phys. Rev.*, **59,** *pp.* 813–819, *May* 15, 1941.—The motion of a particle in a gravitational field is discussed according to general relativity together with additional assumptions. By adopting certain definitions for the momentum and total energy of the particle, and also for the force acting on it, the author derives from the conservation law of the matter tensor 2 relations analogous to Newton's first laws of motion. This is done by a Gaussian integral transformation applied to the conservation law. For weak fields and static matter the geodesic rule for the path of the particle can then be derived. If it is assumed that the scalar density, *T*, is zero inside the particle, the geodesic rule does not follow from the author's theory. This may be the explanation of the values found by Freundlich for the deflection of light by the sun which are in excess of those derived from the Schwarzschild field. G. C. McV.

1739. **The principle of equivalence in the general theory of relativity.** A. WENZL. *Phys. Z.*, **41,** *pp.* 421–422, 1940. *In German.*—A reply to a note by Sapper [Abstr. 639 (1940)] in which the latter author calls attention to certain alleged difficulties connected with the principle of equivalence. Present author endeavours to expose fallacies in Sapper's reasoning. W. W. W.

1740. **The principle of equivalence in the general theory of relativity.** K. SAPPER. *Phys. Z.*, **41,** *pp.* 422–425, 1940. *In German.*—Further considerations regarding what the author feels are inconsistencies in the principle of equivalence. Attempt to refute objections by Wenzl and Weizsäcker. W. W. W.

SOLUTION.

1741. **Speed of germ formation in supersaturated solutions as a means of determining states of solution. I. Solutions of $KClO_3$. II. Solutions of paraffin chain salts.** J. STAUFF. *Z. phys. Chem. A*, **187,** *pp.* 107–129, *Aug.*, 1940. *In German.*—A method was developed for registering the germ formation by photo-electric means and thus determining the speed as a function of supersaturation and of concentration. For the $KClO_3$ solution agreement with theory is satisfactory. Although a quantitative determination of the number of molecules is not possible, as some of the factors are still unknown, the state of solution may be determined. The same method was applied to the investigation of more complicated solutions of paraffin-chain salts (e.g. Na laurate, Na palmitate). In those cases where the state of solution is known, measured and calculated results agree. Therefore the method appears to be suitable for determining unknown states of solution. The existence of a second kind of micelles in these solutions is proved and the concentration of formation determined [see Abstr. 1109 (1941)]. There is a marked difference in the behaviour of these solutions and those of ordinary electrolytes dealt with in the first part of the paper. R. N.

1742. Retroflex aqueous solubility curves, and the respective solubilities of the monohydrate and monodeuterate of MnSO$_4$ in ordinary and in deuterium water. R. D. EDDY, P. E. MACHEMER AND A. W. C. MENZIES. *J. Phys. Chem.*, **45,** *pp.* 908–915, *June*, 1941.—A 50-fold decrease in molal solubility is found with the rise of temperature. At 138°C. equimolecular quantities of the 2 varieties of water dissolve numbers of molecules of the corresponding monoaquated solutes that stand in the ratio of 100 to 56. The greatest relative solubility differences occur at the lowest concentrations, whether these are met with at lower or at higher temperatures. AUTHORS.

1743. Solubility in water of the Ba, Ca, and Mg salts of sulphamic acid. G. B. KING AND J. F. HOOPER. *J. Phys. Chem.*, **45,** *pp.* 938–942, *June*, 1941.

1744. Supersaturation and Liesegang ring formation. A. VAN HOOK. *J. Phys. Chem.*, **45,** *pp.* 879–884, *June*, 1941.—The Morse and Pierce relation for rhythmic precipitation, $x/\sqrt{t}=$const., has been derived independently of the usual assumption of the existence of a definite supersolubility product. In the presence of an inhibitory seed density the extent of band formation decreases as the initial concentration of inner reactant is increased. The experimental results in the working region are indefinite and show only this trend. There are no particularly valid objections to a supersaturation theory of Liesegang ring formation ; moreover, it offers the advantages of directness and simplicity. AUTHOR.

SURFACE PROPERTIES.

1745. Simple derivation of Langmuir's isothermal equation of adsorption. H. DUNKEN. *Z. phys. Chem. A*, **187,** *pp.* 105–106, *Aug.*, 1940. *In German.*—The law governing adsorption as given by Langmuir [Abstr. 1279 (1918)] is derived in a simple manner corresponding to that used for the law of mass action. Thus the nature of adsorption as a bimolecular, and of desorption as a monomolecular, reaction is made apparent and the meaning of the mathematical expression for the quantity adsorbed is elucidated. R. N.

1746. Problem of surface viscosity of liquids. H. E. R. BECKER. *Ann. Phys., Lpz.*, **37,** 5–6, *pp.* 403–414, 1940. *In German.*—It is shown that surface viscosity would result in an abnormal damping of standing capillary waves, and that such an effect cannot be observed within present limitations of measuring techniques. For this purpose the author's method of measuring capillary waves is developed into a high-precision method and applied to measure the damping of standing capillary waves in water and mercury, and it is shown that in all cases the damping is exponential and not abnormal. M. S. V.

1747. Molecular volume and structure. I–II. T. W. GIBLING. *J. Chem. Soc.*, *pp.* 299–309, *June*, 1941.—The bases of the method in general u[illegible]he calculation af parachors are discussed, a[illegible]s suggested that atomic and structural eq[illegible] should be replaced by group values. The difference in parachor corresponding to addition of a CH$_2$ group appears to show regular progressive increase throughout any homologous series of compounds, except among the earlier members. The new method gives satisfactory agreement between calculated and mean observed values, and also leads to the better elucidation of problems of structure.—Reductions in parachor produced by bent chains of atoms occurring in aliphatic hydrocarbons, alkyl ethers and esters, are discussed, and the problem of apportioning suitable values to groups involving linkage of heterogeneous atoms is considered in relation to the parachors of alkyl ethers and esters. AUTHOR.

1748. Investigation of the tension mechanisms responsible for lens formation and a new method for measuring the angles of liquid lenses. N. F. MILLER. *J. Phys. Chem.*, **45,** *pp.* 1025–1045, *June*, 1941.—The total lens angles and related tensions of a series of 10 organic liquids on water were measured. The ability of a given liquid to form lenses on water may be due to 1 of 4 different tension mechanisms which are described. An equation is given for calculating $(-\Delta f_0)$, the free-energy decrease which occurs through the orientation of molecules in a film on a substrate. It is shown that, if a liquid establishes a lens-film equilibrium on a substrate, the magnitude of the total lens angle depends upon the value of $-\Delta f_0$. A new method is described for measuring the total internal angles of liquid lenses. This method may also be used to measure the angle of contact of small drops resting on plane solid surfaces. A table of 143 values of angles (correct to $\pm 0{\cdot}01°$) for spherical segments of volumes from 0·0005 to 0·0200 cm.^{3} and of widths from 0·25 to 1·00 cm. is presented. AUTHOR.

1749. Structure of condensed monomolecular films. A. E. ALEXANDER. *Trans. Faraday Soc.*, **37,** *pp.* 426–437, *Aug.*, 1941.—A brief review and discussion of the various theories advanced to explain the force-area and surface-potential curves and the physical states given by condensed monolayers is given. In particular the recent theory of Dervichian, which seeks to draw a very close analogy between 2- and 3-dimensional structures, is critically examined and numerous objections raised against its general validity.—Concentrating particularly upon those compounds examined by both force-area and surface-potential methods, practically all known condensed monolayers are discussed in relation to the theories given. Attention is focused upon the packing of the head-groups and long-chains and upon the orientation of the resultant dipole as indicated by the surface potential measurements. In certain cases a reasonably definite monolayer structure can be advanced. Generalizations from these results will be discussed in a separate publication. AUTHOR.

See also Abstract 1755.

TIME.

***1750. The light flash time measurer, a new instrument for measuring short and long time intervals.** K. BÖTZ. *Z. techn. Phys.*, **21**, *pp.* 228–232, 1940. *In German.*—The essential parts are : (1) a rotating drum which carries a scale ; (2) 2 instantaneous sparks which are arranged with a lens and diaphragm each, so that one illuminates the upper and the other the lower part of the scale ; (3) a camera which photographs the scale of the drum ; (4) a thyratron-controlled mechanism to release the sparks. If the 2 sparks flash simultaneously, the upper and lower parts of the scale appear in exact juxtaposition on the photograph. If one spark delays against the other, the lower half of the scale is shifted with respect to the upper half in the photograph. From this shift and the known speed of revolution of the drum the length of the time interval can be determined with an accuracy of about 5×10^{-7} sec. (drum with 6000 rev./min., duration of spark 10^{-6} sec. or less). For time intervals longer than 1 drum rev. a second drum running at 10^{-2} of the speed of the first is photographed on the same film. The advantages claimed for this instrument are : its high accuracy, ease of reading the record, adaptability for short and long time intervals, ease with which the adjustment and accuracy can be tested in each series of measurements. G. H. D.

VISCOSITY AND FRICTION.

1751. Viscosities of homologous series at equal temperatures. A. H. NISSAN AND A. E. DUNSTAN. *J. Inst. Petrol.*, **27**, *pp.* 222–225, *June*, 1941.

1752. Viscosity of ethylene-glycol. E. ESTEL. *Phys. Z.*, **41**, *pp.* 413–415, 1940. *In German.*—Measurements of the coefficient of viscosity of ethylene-glycol have been made over the temperature range from 22·8°C. to 76·1°C., using a Höppler viscometer in conjunction with an ultra-thermostat. Two runs over this range are published giving the viscosity coefficients at intervals of about 1°C., and the results are also plotted on a graph giving the logs of the coefficient as a function of the temperature. The values for the coefficients are stated to be accurate within 0·1%, on the whole, with an occasional extreme variation between the 2 runs of 0·3%, while the temperatures are believed accurate to 0·01°C. W. W. W.

1753. Viscosity of chocolate. J. STANLEY. *Industr. Engng Chem.* (*Analytical Edition*), **13**, *pp.* 398–405, *June* 16, 1941.—The theory and technique of the MacMichael viscometer applied to determine the viscosity of chcocolate are examined. A standard technique is described to embrace the entire range of chocolate viscosities on the same basis. The factors influencing viscosity are discussed—cocoa butter, lecithin, moisture, air, fineness, and temperature. AUTHOR.

1754. Friction and adhesion. J. J. BIKERMAN. *Phil. Mag.*, **32**, *pp.* 67–76, *July*, 1941.—A critical discussion of recent literature on, and theories of, friction leads to the following conclusions. Friction cannot be due to welding, as the law of friction and its numerical constant may be identical for the pairs Pt/Pt, Pt/wood, and wood/wood ; nor to adhesion in general as no adhesion can be detected by measuring the normal force. Coulomb's law cannot be reconciled with the adhesion hypothesis by assuming the real area of contact to be proportional to the load ; the assumption is refuted by experiments using decreasing loads. In experiments, which seemed to prove that friction was not due to the surface roughness, not the real friction, but mainly scratch hardness, was measured. " Stick-and-slip " patterns have no bearing on the mechanism of friction. The absolute values of the coefficient of friction are accounted for by Coulomb's theory attributing friction to surface asperities. N. M. B.

1755. Effects of surface finish. J. T. BURWELL, J. KAYE, D. W. VAN NYMEGEN AND D. A. MORGAN. *J. Appl. Mech.*, **8**, *pp.* 49–58, *June*, 1941.—Various commercial surface finishes are produced on steel shafts, and it is found that the finish has little effect on the operation of a journal bearing in the region of hydrodynamic lubrication but does markedly affect the load capacity. A chemical method of detecting iron in oil is developed, with a sensitivity of 1 : 10^7. This method is used to measure the iron removed during running-in from shafts with different surface finishes and under different loads. AUTHORS.

See also Abstract 1746.

ASTRONOMY AND ASTROPHYSICS.

PLANETS.

1756. 1939–1940 apparition of Mars. H. M. Johnson and W. H. Haas. *J. Roy. Astr. Soc. Can.*, **35**, *pp.* 185–202, *May–June*, 1941.—A composite map is reproduced from individual observations by 3 observers in the U.S., using reflectors and refractors up to 12 in. aperture. Photographs taken on a 12 in. reflector are also discussed. The surface is described with special reference to the polar caps, limb and terminator projections, and surface colours. A. Hu.

STARS.

1757. Two interesting nuclei of planetary nebulae: IC 418 and NGC 40. P. Swings and O. Struve. *Proc. Nat. Acad. Sci., Wash.*, **27**, *pp.* 225–229, *May*, 1941.—Examination of the spectra of these objects confirms that planetary nuclei can be divided into 2 classes : those of the Wolf-Rayet carbon type, which show no trace of nitrogen but are surrounded by nebulosity showing the forbidden N II lines strongly ; and those with spectra showing C and N lines in about equal intensities. No nucleus yet found can be placed in the nitrogen sequence of Wolf-Rayet stars. On the other hand, no Wolf-Rayet star without visible nebulosity is intermediate between types WC and WN, as are the planetary nuclei in the second class above. A. Hu.

1758. Escape of continuous radiation from stellar atmospheres. W. M. H. Greaves. *Mon. Not. Roy. Astr. Soc.*, **101**, 3, *pp.* 143–160, 1941.—The author traces the theoretical and observational developments of the subject since the discovery of serious deviations from black-body conditions in stellar radiation. The Balmer discontinuity and the discrepancies between calculated ionization temperatures and observed colour temperatures are discussed, and it is shown that the assumption of a constant absorption coefficient must be abandoned. Further progress awaits solution of the purely mathematical difficulty arising when a total absorption coefficient varying with frequency is employed, and also of the observational difficulty of deciding exactly what form this variation takes. The effect of convective transfer may also have to be added to that of radiative transfer. The task is thus primarily one for the mathematical physicist, though the author indicates directions in which observation can be usefully extended. A. Hu.

1759. Constitution of diffuse matter in interstellar space. O. Struve. *J. Wash. Acad. Sci.*, **31**, *pp.* 217–258, *June* 15, 1941.—The author summarizes the efforts made up to the present to detect interstellar matter and to study its properties by considering light dispersion, general and selective absorption, diffuse radiation, star counts, stellar dynamics, and discrete absorption lines in stellar spectra. The paradox of the high Na/Ca abundance ratio in interstellar space is shown to be removed when the power of H atoms to supply free electrons is taken into account. The author's recent work with the McDonald nebular spectrograph on interstellar emission lines is discussed and illustrated, special attention being given to the H emission round the hotter stars, to the forbidden O II and O III lines, and to the bearing of the observations on our knowledge of interstellar abundances. Finally a table is given showing the composition of interstellar gas, and the directions in which observations need urgent extension are indicated. A. Hu.

SUN.

1760. Final relative sunspot-numbers for 1940. W. Brunner. *Terr. Magn. Atmos. Elect.*, **46**, *pp.* 219–221, *June*, 1941.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

1761. Geophysical measurements. Resistance methods of radio prospecting. II. V. Fritsch. *Arch. techn. Messen*, *No.* 105, *V*65–17, *March*, 1940. *In German.*—Measuring appliances for capacitance methods based on the heterodyne and the "tearing" principle are described and diagrams of connections are given. With the tearing principle the jump in anode current with varying capacitance is observed. The different methods of representing test results and determining the depth of the layer are discussed. Methods using only 1 aerial and inductive coupling to replace the capacitance method are dealt with. [See Abstr. 459B (1940)]. R. N.

HYDROSPHERE, PHYSICS OF THE.

1762. Variations in water level in the Baltic. B. HELLSTRÖM. *Tekn. Tidskr.* (*Väg- o. Vattenbyggn.*), **71,** *pp.* 17–30, *Feb.* 22, 1941. *In Swedish.*—The author applies theoretical calculations to the effect of wind and atmospheric pressure on the fluctuations in water level of the whole of the Baltic and the Bay of Bothnia, with considerable success. Fluctuations due to seiches, or to precipitation etc., cannot be dealt with in this manner. Detailed charts and diagrams are given, various notable floods are discussed, and the oceanographic features of the whole basin are described. ED.

LAND, PHYSICS OF THE.

1763. Consolidation settlement of a soil with an impervious top surface. M. A. BIOT AND F. M. CLINGAN.. *J. Appl. Phys.*, **12,** *pp.* 578–581, *July*, 1941.

METEOROLOGY.

1764. Atmospheric pollution in Dublin during the year 1940. A. G. G. LEONARD, B. P. MCVERRY AND D. CROWLEY. *Sci. Proc. Roy. Dublin Soc.*, **22,** 41, *pp.* 399–404, *July*, 1941.

1765. Interpretation of temperature measurements made at high levels. J. C. BALLARD. *Mon. Weath. Rev., Wash.*, **69,** *pp.* 33–40, *Feb.*, 1941.—Possible sources of error in high-level temperature measurements by balloon meteorographs include insolation during daytime flights, radiation from the instruments during night observations, and lag in the temperature elements during the ascent. Observations are described in which different instruments, with different insolation and radiation characteristics, are used simultaneously. From observations so made, with balloons released before and after sunset, it is considered that insolation cannot cause errors of as much as 5°C. in the Fergusson thermograph for levels up to 26 km. It is therefore concluded that a real diurnal temperature variation occurs at all levels up to 26 km. The day-to-day temperature changes at 24 km. and higher are in the same direction as at ground level. On account of lag the recorded temperatures in the high-level inversion may actually be lower than the true values. A. HU.

1766. Influence of azimuth errors on wind estimation by radio sounding of the atmosphere. O. KIHM AND R. SÄNGER. *Schweiz. Arch. angew. Wiss. Techn.*, **7,** *pp.* 61–68, *March*, 1941. *In German.*—The authors examine the question of what accuracy is needed in radiosonde azimuth observations in order to give the precision required in wind estimation for the purpose of military ballistics. Assuming that the observations are carried out at 1 min. intervals from 3 stations 5000 m. apart at the corners of an equilateral triangle, a max. permissible mean error of $\pm\frac{1}{3}$ m./sec. in the ballistic wind requires an accuracy of $\pm\frac{1}{2}^\circ$ in the separate azimuth determinations. Errors due to lack of simultaneity in the several observations are less important. A. HU.

***1767. Electronic humidity meter.** E. MOEN. *Electronics*, **14,** *pp.* 76 *and* 78, *June*, 1941.

***1768. New dew-point apparatus as a means for fuel economy in industrial drying plant .** E. KOBEL. *Schweiz. Arch. angew. Wiss. Techn.*, **7,** *pp.* 112–114, *April*, 1941. *In German.*—A cylindrical copper vessel, with its observation end chromium plated and highly polished, is supplied with a current of warm water from an electrically heated source, so that its temperature can be varied continuously between 10° and 100°C. So long as the temperature of the reflecting surface of the apparatus is above the dew-point, the reflecting power is of the order of 80–97%, but when the dew-point is reached this drops below 50%. Observation of the reflected beam, furnished by a small projector, may be visual or by means of a photo-cell. A. W.

1769. Dual rainfall regime of Roswell, New Mexico. P. R. CROWE. *Mon. Weath. Rev., Wash.*, **69,** *pp.* 40–47, *Feb.*, 1941.—The author enquires how far the assumption of a single " true normal " regime of precipitation is justified by the facts in climatologically transitional regions. If there are in such regions 2 alternative normals, the ordinary method of calculating mean monthly rainfall values will fuse arithmetically 2 tendencies which should remain distinct. A test case is made of Roswell, where the records for the period 1895–1938 are examined with a view to detecting any duality caused by the transition from the Plateau type to the Plains type of rainfall. A prima facie case is made out for such a duality, and it is suggested that in other transition zones, too, the borderline is not the broad fringe suggested by the ordinary analysis of means, but a narrow band migrating back and forth from year to year. A. HU.

1770. Fifty years' weather in Kansas City, Mo. 1889–1938. A. M. HAMRICK AND H. H. MARTIN. *Mon. Weath. Rev., Wash.*, *Suppl. No.* 44, [53 *pp.*], 1941.

***1771. Recent developments in meteorological instruments.** F. J. SCRASE. *J. Sci. Instrum.*, **18,** *pp.* 119–125, *July*, 1941.—The author reviews recent work in adapting meteorological apparatus to give remote indication or remote recording. New developments in anemometers, pilot-balloon theodolites, and night-visibility meters are described, as also are recent designs of radio-meteorographs in which alterations in the indications of pressure, temperature and humidity elements, interrupt a radio signal or vary its frequency or the modulation frequency in an interpretable way. A. Hu.

SEISMOLOGY.

1772. Friction in buildings—its magnitude and its importance in limiting earthquake stresses. M. P. White. *Bull. Seism. Soc. Amer.*, **31,** *pp.* 93–99, *April,* 1941.—A building vibrator capable of generating periodic forces of adjustable frequency and intensity was used at various speeds and with different forces and the forced vibrations recorded by vibration meters at different points of a building in Los Angeles, symmetrical in plan and section and with no other buildings near by. For basement motion the roof response was calculated from earthquake records and the true fundamental period found. Using this period the damping ratio was found to be 0·8 or 0·85 compared with 0·80 from the shaker investigation. R. S. R.

1773. Calculating the response of an oscillator to arbitrary ground motion. G. W. Housner, *Bull. Seism. Soc. Amer.*, **31,** *pp.* 143–149, *April,* 1941.—Employing Rayleigh's principle of superposition an expression is found for the response of an oscillator in terms of the ground acceleration and also of the ground displacement. Use of the former has proved to be the more satisfactory. A method is described for obtaining the envelope of the oscillator response, and spectra are drawn giving the displacement/frequency and the force/frequency for the earthquake of Oct. 2, 1933. G. E. A.

***1774. Low-cost vertical component seismograph with viscous coupling.** J. McFarland. *Bull. Seism. Soc. Amer.*, **31,** *pp.* 139–142, *April,* 1941.—A full description of the details of the instrument is given with diagrams. The variation of period obtainable is from 2 to 12 secs. while the magnification is 38. R. S. R.

***1775. Mechanical analyser for the production of earthquake stresses.** M. A. Biot. *Bull. Seism. Soc. Amer.*, **31,** *pp.* 151–171, *April,* 1941.—A mechanical analyser for the evaluation of the earthquake spectrum is described. Spectrum curves obtained with the analyser from acceleration records of various destructive earthquakes are discussed. It is then shown how spectrum curves can be used to predict earthquake stresses in complex structures, such as a building with an elastic first floor or the San Francisco Oakland Bay Bridge. These results must be modified by the effects of damping or other causes of stress reduction. R. S. R.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

1776. Cloud and earth lightning flashes. J. A. Chalmers. *Phil. Mag.*, **32,** *pp.* 77–83, *July,* 1941.—Tropical thunderstorms differ from those occurring in temperate regions in having a greater proportion of discharges inside the thunderclouds; furthermore, conditions arise in winter in England which are meteorologically similar to those existing in thunderstorms but which do not give rise to lightning flashes. The author explains these facts on the supposition that the differences depend on differences in temperature levels and cloud levels. The process of separation which gives rise to the negative charge near the 0°C. isothermal and the positive charge in the upper part of the cloud is considered; then, assuming Wilson's theory of potential variation, a mathematical discussion shows that a high dew-point such as would occur in the tropics is associated with an internal discharge rather than with a flash to earth. Similarly, low clouds in cold humid air, such as occur in the English winter, cannot build up a sufficiently high potential gradient to produce a flash. A. Hu.

1777. Daily variation of irregular disturbances of the earth's magnetic field at Bombay. R. Narayanaswami. *Terr. Magn. Atmos. Elect.*, **46,** *pp.* 147–162, *June,* 1941.—As a measure of the disturbance the departures of the hourly ranges of the horizontal forces from the mean hourly range on the 5 international quiet days in that particular month were used. In calculating the disturbance due regard was paid to the sign of the change of the element during the hour. The diurnal variations of the irregular disturbances depend on the season of the year and on the sunspot activity. These variations are analysed and compared with the results of disturbance diurnal variation in higher latitudes. The main conclusions are: (*i*) The hour of min. disturbance occurs early in the morning and that of the max. about noon. (*ii*) There are 2 secondary max. (*iii*) Analysing the results according to month, the day max. is most pronounced in the months April to August. In the winter months there is a tendency for the variation to approach the European type. (*iv*) If days of magnetic character 2 are excluded, the diurnal variations are similar, but the late evening max. is suppressed, leaving the noon max. more pronounced. In low magnetic latitudes the main variation is a max. near noon with a min. a little before sunrise. The evening max. of temperate latitudes is superposed on this simple variation. It is suggested that the max. of disturbance-variation at Bombay at about noon and in the afternoon are associated with the max. of ion density in the E- and F_1-layers and in the F_2-layer, respectively. The late evening max. is presumably due to fluctuations in F_2-layer caused by electrified particles from the sun concentrating on the night side of the earth on account of the deflecting action of its magnetic field. AUTHOR.

1778. Isomagnetic charts. V. The occurrence of local dip-poles. S. CHAPMAN. *Terr. Magn. Atmos. Elect.*, **46**, *pp.* 163–172, *June*, 1941.—[Abstr. 1230 (1941)]. It is shown that local magnetic dip-poles occur in pairs or groups of pairs, and the nature of the isomagnetic lines and magnetic meridians is illustrated in the simpler cases. It is also shown that a local magnetic disturbance due to a single magnetic pole, if sufficiently intense, can produce one pair of dip-poles, and that, if the disturbance is due to the field of a sufficiently intense local dipole, there may be either 1 or 2 local pole-pairs, according to the orientation of the dipole. If the dipole field is due to magnetization induced in a roughly spherical mass of magnetite or iron pyrites by the existing normal field, the necessary susceptibility of the mineral, if it is to produce local dip-poles, is shown to depend on the ratio of its radius to its depth and on the local value of the normal horizontal intensity *H*. A classification of pole-pairs according to this value of *H* and the distance between the poles of a pole-pair is suggested. AUTHOR.

1779. Magnetic horizontal intensity at Oslo, 1843–1930. K. F. WASSERFALL. *Terr. Magn. Atmos. Elect.*, **46**, *pp.* 173–218, *June*, 1941.—Results based on magnetic data left by Hansteen and on the work done by his successors.

RADIOACTIVITY.

1780. Scattering of α particles on C. W. RIEZLER. *Ann. Phys., Lpz.*, **38**, 4, *pp.* 304–314, 1940. *In German.*—Description of a method to carry out scattering measurements for thick scatterers, without the usual difficulty arising from uncertainty in the energy of the colliding particle. It is used to study the scattering from C. Anomalous scattering occurs when the incident energy is 4·2 eMV for the *S*-wave, 5·0 for the *P*-wave. There is a resonance level at 4·6 eMV which is ascribed to the *D*-wave. The corresponding *D*-term of O^{16} must lie 10·8 eMV above the ground state. The radius of C^{12} is about $4{\cdot}1 \times 10^{-13}$ cm. M. S. V.

1781. β-ray energy of H^3. S. C. BROWN. *Phys. Rev.*, **59**, *pp.* 954–956, *June* 15, 1941.—The max. energy of the H^3 β-ray spectrum has been measured by its absorption in He. The detector was a screen-wall counter with He at atm. pressure flowing through it at all times. The max. range of the H^3 β-rays in He was determined as 13 ± 1 mm. corresponding to a max. energy of $9{\cdot}5 \pm 2{\cdot}0$ ekV. AUTHOR.

1782. Theory of the meson decay. S. SAKATA. *Proc. Phys.-Math. Soc., Japan*, **23**, *pp.* 283–291, *April*, 1941.—By combining Yukawa's theory of nuclear forces with Fermi's theory of the β-disintegration, a new theory of the meson decay is proposed. The resulting life-time of the meson agrees with cosmic-ray observations. AUTHOR.

1783. Pair production by γ-rays from F bombarded with protons. K. SHINOHARA AND M. HATOYAMA. *Sci. Pap. Inst. Phys. Chem. Res., Tokyo, No.* 1015, *pp.* 253–262, *April, and No.* 1023, *pp.* 326–327, *May*, 1941.—A cloud-chamber method was used to study the pair production by γ-rays from F bombarded with protons. The energy of the γ-rays was found to be $6{\cdot}2 \pm 0{\cdot}1$ eMV. The division of energy between negative and positive electrons was investigated. A. J. M.

1784. Purification of radon. P. A. MACDONALD AND M. S. MARGOLESE. *Rev. Sci. Instrum.*, **12**, *pp.* 320–325, *June*, 1941.—A radon plant of simple design and construction is described. AUTHORS.

RADIATION.

COLORIMETRY.

1785. Colorimetric study of interference colours. I–II. E. BUCHWALD. *Ann. Phys., Lpz.*, **38**, 4, *pp.* 245–260, *and* **38**, 5, *pp.* 325–339, 1940. *In German.*—An analysis similar to that of Baud and Wright [Abstr. 3972 (1930)] of the colours produced by observing quartz plates between Nicol prisms. Illuminant B and the standard observer adopted by the C.I.E. in 1931 were assumed. It is shown that in a colorimeter of the type suggested by Arons, employing 2 quartz plates, the colour gamut exceeds that of the Ostwald Atlas. The possibility of employing this type of instrument as a general-purpose colorimeter is emphasized.—The same type of analysis is carried out for the case of gypsum. It is shown that, unlike quartz, plates of gypsum are unsuitable for use in colorimetry. The observed agreement with theory indicates that the results should be valid in the case of any birefringent crystal free from anomalous dispersion. M. S. V.

1786. Classification of colour-measuring methods. M. Richter. *Arch. techn. Messen, No.* 105, *V*433–3, *March*, 1940. *In German.*—Sensimetric methods are based on Grassmann's law of additive colour mixing. They may be subdivided into equality or compensation methods, spectral methods, and brightness methods, these latter using heterochromous filters. Besides these a considerable number of empirical methods are used for special requirements. A Bibliography of 12 publications is given. R. N.

EMISSION.

1787. Theory of radiation. I. First-order wave equation for the potential of the radiation field. G. Molière. *Ann. Phys., Lpz.*, **37,** 5–6, *pp.* 415–420, 1940. *In German.*—It is shown that the differential equation for the vector and scalar potentials can be broken up into 2 linear equations of first order. The question of whether this process leads to negative energy values for the photon is discussed, and is shown to depend on the choice of the method of splitting up the radiation field into a clockwise and an anti-clockwise part. M. S. V.

1788. A formalism for the definition of an atomic radiation process. J. Fuchs. *Ann. Phys., Lpz.*, **38,** 4, *pp.* 315–324, 1940. *In German.*—The author suggests that the Planck constant h should be defined by $h = \frac{1}{2}e^2 z_0/\alpha$, where e is the electronic charge, z_0 the characteristic impedance of empty space, $\sqrt{\mu_0/\epsilon_0} = 377\,\Omega$, and α the Sommerfeld fine-structure constant, constituting a purely electrical definition independent of atomic models. The definition of the energy quantum is to be as follows : If a material particle possesses an energy W in the most general sense in a definite frame of reference, there exists in this frame a singular phenomenon of duration T, which is defined by the equation $WT = h$. The time T is interpreted as the duration of a single act of emission of a photon. Experimental evidence is given in support of this interpretation, although no satisfactory explanation is offered for the coherence length of many millions of wavelengths. It is also proposed to consider the so-called electron radius $r_0 = 2{\cdot}81 \times 10^{-13}$ cm. not as a fundamental length but as a fundamental elementary capacitance. M. S. V.

1789. New measurements of the pressure and temperature effects of cosmic radiation. F. Göttlicher and W. W. Dittrich. *Phys. Z.*, **41,** *pp.* 402–406, 1940. *In German.*—Observations were taken over a period of about 9 months with a counter telescope pointed vertically. The telescope consisted of 4 steel-walled counters, 48 × 900 mm., filled with argon and alcohol vapour. Coincidences were recorded between the 1st and 3rd counter in the train and between the 2nd and 4th, so that 72·8% of the rays recorded by 1 pair of counters were also recorded by the other. The observations were grouped in periods of the solar rotation (27 days) and multiple correlation coefficients were calculated with the barometric pressure and the external temperature of the air. The variations in the cosmic-ray intensity with pressure were quite consistent and led to a pressure coefficient of − 2.17%/cm.Hg for 1 pair of counters and − 1·82%/cm. for the other. The temperature correlations were not so regular and were − 0·12%/deg. and − 0·17%/deg. for the 2 pairs of counters. W. W. W.

1790. Nuclear particles in the cosmic radiation. S. A. Korff. *Phys. Rev.*, **59,** *pp.* 949–954, *June* 15, 1941.—A series of balloon flights employing proportional counters has been carried out. In these flights the instrument measures the number of events liberating more than an assignable min. of ionization in the instrument. The contribution due to each of several types of such events is evaluated, the effect of large showers is considered and instrumental errors are discussed. It is found that α-particle counts due to slow-neutron-induced B disintegrations may account for about $\frac{1}{3}$ of the discharges observed with BF_3 counters. Counters in which other gases are used permit an estimate to be made of the flux of highly ionizing particles, mostly protons, which is found to be about 10^{-3}/cm.^{2}/sec. These data permit the calculation of the rate of production of protons, which is found to be of the same order as that of neutrons, namely about 5×10^{-2}/g./sec. at the altitude corresponding to 2 m. of water equivalent below the top of the atmosphere. The energy distribution, the amount of the flux and the altitude dependence, suggest that both protons and neutrons are produced about equally by a process or processes connected with the soft component of the radiation. Author.

1791. Study of thermal neutrons in the atmosphere. S. D. Chatterjee. *Indian J. Phys.*, **14,** *pp.* 435–440, *Dec.*, 1940.—The intensity of thermal neutrons in the atmosphere has been measured at sea level (Calcutta 70 ft.) and at a higher altitude (Darjeeling 7 000 ft.), using a boron-lined propor-

tional counter. A preliminary measurement of the size/frequency distribution of the energies of the disintegration particles from B by the action of atmospheric neutrons has been carried out at the higher altitude with a BF_3 ionization chamber.
AUTHOR.

*1792. **Monochromatic source of mercury resonance radiation.** L. B. THOMAS. *Rev. Sci. Instrum.*, **12,** *pp.* 309–312, *June*, 1941.—The strong absorption and subsequent re-emission of Hg resonance radiation in Hg vapour has been utilized in the construction of a highly monochromatic and moderately intense source of λ2 537. The construction and performance of the lamp are described and a rough analysis shows the line half-breadth to be about 20% greater than the ideal Doppler half-breadth at room temperature.
AUTHOR.

FLUORESCENCE & PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

1793. **Remarkable fluorescence of certain Coumarin derivatives.** S. RANGASWAMI, T. R. SESHADRI AND V. VENKATESWARLU. *Proc. Indian Acad. Sci. A*, **13,** *pp.* 316–321, *April*, 1941.—A number of umbelliferone derivatives with acetyl, benzoyl, carbethoxyl or carboxyl groups in the 3-position have been prepared, of which 6 are new. The fluorescence exhibited by these is studied and the results are discussed. AUTHORS.

1794. **Spectrum photometric investigations with a commercial phosphorescent paint substance.** M. SCHILLING. *Z. techn. Phys.*, **21,** *pp.* 232–239, 1940. *In German.*—The spectral curve of the phosphorescent light of a commercial phosphorescent paint substance ("Green N" of the J. D. Riedel and E. de Haën A.G.) was ascertained and compared with that of other phosphorescent substances (SrSBi and sidotblende). The paint had its max. at 573 mμ with ½ width of 80 mμ. The visual efficiency is 28% for rod vision, 76% for cone vision. The study of the decay showed that 59·5% of the total energy is radiated in the first 6 min., 23·8 from 6 mins. to 1 hr., and 16·7% from 1 hr. to ∞. The decay curve depends for times below 20 sec. on the frequency of the exciting line but is independent of it for longer times. The subjective intensity curve in terms of the threshold value of the eye and the dependence of the phosphorescent intensity on various kinds of excitation are given. The angle dependence of the diffuse emission and reflection coefficients agreed fairly well with Lambert's law. The absolute value of the diffuse reflection coefficient is 90·2% for the pure paint substance and decreases if the layer is very thin or other substances are mixed with it. The reflectivity of the unexcited phosphor is always larger than that of the excited substance. A room painted with this substance retains a useful luminiosity for several hours after the light is turned out. G. H. D.

See also Abstract 1698.

INTERFERENCE, DIFFRACTION AND SCATTERING.

1795. **Distribution of radiant energy in a group of lattices.** S. T. SERGHIESCO. *J. Opt. Soc. Amer.*, **31,** *pp.* 109–113, *Feb.*, 1941.—The existence of interference fringes can be explained without using the wave theory of light if it is assumed, instead, that the space transmitting the light has a lattice structure with a period equal to the wavelength of the light. R. P.

1796. **Interferometer method of determining amplitudes of small mechanical vibrations.** W. J. KENNEDY. *J. Opt. Soc. Amer.*, **31,** *pp.* 99–101, *Feb.*, 1941.—The theory of this interferometer method by Osterberg [Abstr. 2514 (1932)] is tested experimentally and found to be very accurate. R. P.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

1797. **Photochemical transformation of *trans*- to *cis*-diparatoluyl ethylene.** W. H. MARTIN, H. D. BETT, R. G. ROMANS AND W. TIDRIDGE. *Trans. Roy. Soc. Can., Sect. III*, **34,** *pp.* 35–41, *May*, 1940.—Allan's observation [*J. Amer. Chem. Soc.*, 1923, **45,** 2156] that when *trans*-diparatoluyl ethylene is exposed to sunlight in a silica vessel it is completely changed to the *cis*-isomer in 1–2 hrs. is now examined, and the evidence that a case of *cis-trans* isomerism exists is found to be conclusive. Experimental details are given for the preparation of the two isomerides, but it was found that the photochemical study was limited to excitation by light of wavelength 4 047 Å; the energy entering the solutions was measured by the uranyl sulphate actinometer, but uranyl oxalate was found preferable to the sulphate because it is more easily prepared in a pure state. The apparatus and manipulation details are described at length. Colorimetric analysis was employed for following the *trans-cis* change. It is necessary to assume in a *trans-cis* isomerization that the absorbed quantum of light disrupts the double bond sufficiently to permit of rotation. From the quantum yield of 0·45 it is assumed that the probability of the two parts recombining to give the original *trans* is a little greater than for the *cis*. H. H. Ho.

1798. **Number of quanta required for the developability of a silver halide grain.** L. SILBERSTEIN. *J. Opt. Soc. Amer.*, **31,** *pp.* 343–348, *May*, 1941.—

Webb has shown [Abstr. 4023 (1939)] that if all grains have the same sensitivity, and if a fixed min. number of quanta *r* (assumed to be the same for every grain) are required for developability, then the conclusion arrived at, that *r* must be small, depends directly on the assumption that all grains have the same inherent sensitivity. The present paper takes the view that Webb's contention implies that, if this basic assumption of the same *r* for all grains is given up, the resulting *H* and *D* curves compared with the observed curves would lead to a large average value $\bar{r}$ of the number of quanta required per grain. A mathematical analysis is given with the object of showing that this implication is incorrect. N. M. B.

1799. Number of quanta required to form the photographic latent image as determined from mathematical analysis of the *H* and *D* curve. J. H. Webb. *J. Opt. Soc. Amer.*, **31**, *pp.* 348–354, *May*, 1941.—It is pointed out that in Silberstein's analysis a composite *H* and *D* curve is used, the slope of which is derived by addition of the slopes of the simple *H* and *D* curves for grains of different sensitivity *r*, where *r* varies in a specified manner according to some form *f*(*r*). Certain restrictions are placed on *f*(*r*) and it is conceded that, under these, the analysis and conclusions arrived at are correct. But disagreement with these restrictions is expressed and it is pointed out that a possible form of *f*(*r*) permits large values of *r*. Several forms of *f*(*r*), subject to no arbitrary restrictions, are considered and it is shown that these give curves of the proper shape to agree with observed *H* and *D* curves. N. M. B.

1800. Number of quanta required to form the photographic latent image as determined from intermittent exposures. J. H. Webb and C. H. Evans. *J. Opt. Soc. Amer.*, **31**, *pp.* 355–357, *May*, 1941.—To obtain information directly as to the number of quanta required to produce developability in the grains of a photographic emulsion, experiments are reported on intermittent exposures (with varying frequency of interruption) at room temperature and, with varying total number of exposure instalments, at liquid-air temperature, with intervening "warm-up" periods between exposures. Results, in the first case, give some evidence that at least some grains of the emulsion require from several hundred to 1 000 quanta to produce developability and, in the second case, give additional evidence that a large number of quanta (100 or more) are required for latent-image formation in some grains. N. M. B.

1801. Photographic aspects of the theory of 3-colour reproduction. D. L. MacAdam. *Commun. No.* 680 *Kodak Res. Lab. Photogr. J.*, **81**, *pp.* 333–351, *July*, 1941.—The colorimetric and photographic principles of additive colour reproduction are reviewed. The significance of the concept of photographic spectral sensitivity is examined and the desirability of emulsions having contrast independent of wavelength is emphasized. Two masking methods are described, one of which utilizes unusual types of emulsions to realize completely the desired partially negative spectral sensitivities, and the other of which utilizes conventional materials and techniques to realize a close approximation to the desired sensitivities. The errors of additive colour reproductions resulting from several different compromises in which negative portions of the spectral sensitivity curves are ignored or avoided are computed and compared. The simple omission of all sensitivity in the wavelength regions where the theory calls for negative sensitivity, utilizing only the positive portions of the theoretical spectral sensitivity curve, results in the smallest errors. Finally, the effect of increase of contrast is examined, with the conclusion that purity can be increased, compensating for the loss of purity resulting from the failure to realize partially negative spectral sensitivities, but that considerable errors in dominant wavelength as well as in brightness result from the excessive contrasts. Author.

1802. Test of lens resolution for the photographer. I. C. Gardner. *Circ. U.S. Bur. Stand.*, *No. C*428, *pp.* 1–15, 1941.—This circular provides the photographer with a set of charts by which the resolving power of a photographic lens may be numerically measured with respect to a definite scale of values. A detailed description is given of the procedure and technique to be followed in order that comparable values may be obtained by different observers. The test provides an objective method of testing a photographic lens. Author.

***1803. Small instrument for light flashes for the photography of fast moving objects.** J. Vastmann. *Z. techn. Phys.*, **21**, *pp.* 223–228, 1940. *In German.*—Contains the description of a small portable instrument for the instantaneous illumination of fast moving objects. It consists of a spark gap of 8 mm. length and a condenser charged by a rectified current of 6 000 V. The discharge is actuated by a current impulse between one of the electrodes and an auxiliary electrode halfway between them. This current impulse is furnished by an auxiliary circuit containing a second condenser and is controlled through a thyratron by an automatic switch. If the front of the auxiliary current impulse is sufficiently steep, the uncertainty in the time when the main spark occurs is in the average only $0{\cdot}25 \times 10^{-6}$ sec. The length of the light flash with tungsten electrodes, when self-inductance, capacitance and resistance, of the discharge circuit are chosen suitably, is about $2{\cdot}10^{-6}$ sec.

For the photography of periodically moving objects in a definite phase of their cycle a stroboscopic control can be attached. The instrument is not suitable for cinematographic records, as charging time for the condenser is about 20 sec. G. H. D.

PHOTOMETRY.

***1804. Modified photo-electric photometer.** W. D. Hatfield and G. E. Phillips. *Industr. Engng Chem.* (*Analytical Edition*), **13,** *pp.* 430–435, *June* 16, 1941.—A vertical-type photometer, utilizing 1 or 2 photronic cells and low-form 100 ml. Nessler tubes for absorption cells, is described. Colorimetric *p*H can be determined with greater accuracy than by visual methods, using only 0·25 ml. of indicator in 25 to 100 ml. of sample. Turbidity is easily determined and compensated for in the same sample. Author.

***1805. Simple photo-electric brightness meter.** A. C. Poulter. *J. Sci. Instrum.*, **18,** *pp.* 166–167, *Aug.*, 1941.—A description is given of a simple photo-electric brightness meter designed to assess the brightness of a series of uniform printed half-tones in terms of the brightness of $MgCO_3$ or unprinted paper. Light from a projection lamp is focused on to the print or standard held in a frame which can be placed by stops. The light reflected by the print and standard is compared photo-electrically. Author.

***1806. Non-recording densitometer.** W. S. Baird. *J. Opt. Soc. Amer.*, **31,** *pp.* 179–180, *Feb.*, 1941.—An image of the line to be measured is produced on a viewing screen by means of which the line can be brought to coincidence with the slit of the actual photometer. The light collected by this slit is compared with a beam from the same source that passes through an adjustable aperture, by means of 2 photo-electric cells. Equality of current in the 2 cells is indicated by a "magic eye." Various gadgets for a rapid and accurate setting of the instrument are described. R. P.

POLARIZATION.

1807. Investigations with the polarization of canal-ray glow. S. Richter. *Ann. Phys., Lpz.*, **38,** 1, *pp.* 59–83, 1940. *In German.*—The decrease of polarization of the moving glow of H_2 and D_2 canal rays in He, as the particle velocity increases, was measured in the range 5–40 kV. The polarization is greater for D_2 than for H_2, and is largely similar for excitation with electrons and atoms. It increases for increasing gas pressure in the range from $2·5 \times 10^{-3}$ to $4·5 \times 10^{-3}$ mm. of Hg. For the stationary glow He canal rays were shot in H, H_2 and D_2. H and H_2 show no difference. However, D_2 gives stronger polarization than H_2. The polarization increases as the radiation cross-section increases. From this it is surmised that there is an influence of the Stark effect on the polarization. There seems to be no dependence of the polarization on the current density in canal rays. M. S. V.

1808. Optically active $\alpha\gamma$-diethylallyl alcohol. B. C. Platt. *J. Chem. Soc.*, *pp.* 316–318, *June*, 1941.

1809. Optically active tetrahydrofurfuryl alcohol. M. P. Balfe, M. Irwin and J. Kenyon. *J. Chem. Soc.*, *pp.* 312–316, *June*, 1941.

***1810. Kerr effect oscillograph with 2-dimensional deflection.** F. Eder. *Z. techn. Phys.*, **21,** 9, *p.* 203, 1940. *In German.*—A former arrangement by Trümper is described in which white light passes through a Nicol prism, a Kerr cell with its electric field oriented at an angle of 45° with the plane of polarization of the light, a Babinet compensator, another Nicol prism with its transmission plane parallel to that of the first, and finally to a rotating drum where it is recorded photographically. All the fringes produced by the Babinet compensator are coloured and diffuse except the so-called central fringe which is sharp and white. If a p.d. is applied to the plates of the Kerr cell, the central fringe will move by a predictable amount, and since the relaxation time of the Kerr cell itself is of the order of 10^{-10} sec., very rapid changes in potential should be measurable. The resolving time of this arrangement is limited by the rotating-drum time scale and the light intensity available. Two-dimensional deflection may be obtained by passing the light from the above arrangement through another identical arrangement, except that the Kerr cell and Babinet compensator are rotated about the light beam by an angle of 90°. Now the fringes are split up into dots, all of which are coloured and diffuse except the central dot. The phase difference between alternating potentials applied to the 2 Kerr cells may be determined by the form of the resulting pattern produced on a photographic plate. No data are given on the frequency range through which this instrument was tested. G. H. D.

See also Abstract 1818.

REFLECTION, REFRACTION AND DISPERSION.

1811. Reflection on absorbing media. H. Littmann. *Ann. Phys., Lpz.*, **38,** 2, *pp.* 139–152, 1940. *In German.*—It is shown experimentally that light reflected from an absorbing liquid does not obey Fresnel's formulae. A reflection formula rigorously valid for any angle of incidence, index of refraction and absorption, is derived and its relation to other formulae is shown. The calculated intensity is verified by qualitative measurements. The effect of absorption on the accuracy of refractrometric measurement based on the principle of total reflection is discussed. M. S. V.

1812. The measurement of the refractive power of absorbing fluids. H. Littmann. *Phys. Z.*, **41,** *pp.* 442–447, *Oct.*, 1940. *In German.*—By interferometric and deflection methods the exact measurement of the refractive index uninfluenced by absorption is possible, with an accuracy $dn = 1 \times 10^{-5}$ or better. A method of evaluating n by measurement of the focal length of a zone plate built by the Newton's rings is detailed. The refractive powers of some coloured solutions as determined by the Abbe focometer are compared with values given by the Abbe refractometer, both for the transmitted and the reflected light. Agreement is obtained only with the measurements using reflected light. An explanation in terms of Mach's theory of the perception of contrast by the eye is presented. W. W. W.

1813. Optical investigations in a particular inhomogeneous medium. E. von Heydebrand und der Lasa. *Ann. Phys., Lpz.*, **37,** 8, *pp.* 589–626, 1940. *In German.*—Theoretical study of geometrical optics in a medium where the index of refraction is constant in each of a family of parallel planes but varies linearly along the line perpendicular to these planes. M. S. V.

1814. Test for convex surfaces. E. L. Mc Carthy. *J. Opt. Soc. Amer.*, **31,** *pp.* 107–108, *Feb.*, 1941.—A method of testing is described which is suitable, for example, for the case of a Cassegrain secondary mirror. R. P.

1815. Comparison of 2 recent studies on refraction and dispersion of glasses. J. C. Young and A. N. Finn. *J. Opt. Soc. Amer.*, **31,** *pp.* 383–384, *May*, 1941.—Correlates the results of 2 recent investigations [Abstr. 100 and 246 (1941)]. Work on specific refraction and dispersion is common to both studies and, although in each case these two properties are considered from an apparently different point of view, it is shown that the results obtained are quite comparable. A. H.

1816. Exact and approximate computation of Schmidt cameras. II. F. A. Lucy. *J. Opt. Soc. Amer.*, **31,** *pp.* 358–361, *May*, 1941.—Various forms of the Schmidt camera are discussed in which one spherical and one aspherical surface are employed. These include the reversed-plate Schmidt, in which the aspherical surface faces the mirror, the solid Schmidt, in which the aspherical surface forms one end of a block of glass and the spherical reflecting surface the other end, and the thick-mirror Schmidt, in which the mirror is made from a thick block of glass, plane on one side and spherical on the other. Exact and approx. equations for the aspherical surface are given for these cases. [Abstr. 2637 (1940)]. W. D. W.

1817. Illumination in the focal plane. F. Benford. *J. Opt. Soc. Amer.*, **31,** *pp.* 362–368, *May*, 1941.—The paper reports measurements on 36 camera and projection lenses of the extent to which the illumination at an angle θ to the axis departs from the $\cos^4\theta$ law owing to the vignetting effect of the mounting rings and lens barrel. The results were obtained by measuring the apparent area of the opening of each lens for various angles of rotation of the lens. Curves are given for 3 *f*-numbers for the 36 lenses. Curves are also given to show how the illumination falls off when the object is relatively near the lens, so that the image is formed behind the focal plane. W. D. W.

***1818. The polaroid stereoscope.** R. W. Stamm. *Amer. J. Roentgenol. and Radium Ther.*, **45,** *pp.* 744–752, *May*, 1941.—A stereoscope is described in principle and construction which has advantages over the commonly used Wheatstone stereoscope in that a number of persons, given the necessary spectacles, can view the films simultaneously, the number only being limited by considerations of convenience, 8 persons being easily accommodated by the instrument described. Application of polarization is only rendered practically possible by the invention by Land of a new polarizing screen of large dimensions, utilizing submicroscopic dichroic particles. Polarized light from each of 2 such screens, provided by 2 viewing boxes at rt. angles, is partly transmitted and partly reflected by a semi-transparent glass screen to the observers provided with polaroid spectacles. The construction of the apparatus is given in detail and illustrated. B. J. L.

See also Abstract 1802.

SPECTROSCOPY.

1819. Application of spectrographic methods to the analysis of segregates. F. G. Barker, J. Convey and J. H. Oldfield. *J. Iron Steel Inst.*, [11 *pp.*], *July*, 1941. *Paper read at Sept. Meeting.*—Reference is made to preliminary experiments which showed that routine methods of spectrographic analysis were not applicable to the quantitative analysis of segregates without some modification. Further experiments made with standard graphite electrodes, silver electrodes of various shapes and various spark gaps, to reduce the area affected by sparking are described, also other variations in procedure which were found necessary to increase the line density of the spectrum to permit of estimations being made from a single exposure. The dia. and depth of the crater formed under these conditions are approx. 0·012 in. and 0·0007 in., respectively, and the weight of metal actually involved in the test is approx. 0·000005 g. It is shown that tests on small bars of Ni-Cr-Mo steel give reproducibility of a satisfactory order, and that tests on specimens from large forgings of Ni-Cr-Mo and Ni-V steel containing segregates give higher average values for all elements on the segregates than on the normal metal. AUTHORS.

1820. Emission spectra of the rare-earth elements. W. F. MEGGERS. *J. Opt. Soc. Amer.*, **31**, *pp.* 157–159, *Feb.*, 1941.—For the rare earths, with their almost indistinguishable chemical properties, spectrographic methods are superior in principle to ordinary chemical methods of analysis, but are hampered by lack of knowledge of the spectra. The available information on these spectra is summarized. R. P.

1821. Precision method for measurement of wavelengths of diffuse lines. W. W. A. JOHNSON AND D. NORMAN. *J. Opt. Soc. Amer.*, **31**, *pp.* 177–178, *Feb.*, 1941.—In the case of an asymmetric line the point that is of greatest theoretical significance is the centre of intensity. Since in general this can only be determined from a microphotometer curve after it has been converted to intensity from blackening, its determination is very cumbersome. An approx. method is outlined which gives results of sufficient accuracy for most practical purposes. R. P.

1822. First spark spectrum of Te. K. R. RAO AND M. G. SASTRY. *Indian J. Phys.*, **14**, *pp.* 423–427, *Dec.*, 1940.—Based on an extensive experimental study of the emission spectrum of Te, the general features of the structure of the first spark spectrum of the element have been identified. A related system of quartet and doublet terms has been set up, involving the characteristic terms of the $5s$, $6s$ and $6p$ electron configurations of the singly ionized atom. The ionization potential of Te II is found to be 21·5 V approx. AUTHORS.

1823. Interferometric measurements of certain lines in the spectrum of bromine. M. G. SASTRY. *Indian J. Phys.*, **14**, *pp.* 430–433, *Dec.*, 1940.—Using a Fabry-Perot étalon in conjunction with a Hilger quartz Littrow spectrograph the wavelengths of 9 lines in the spectrum of Br II have been measured. Vacuum Cu arc lines $\lambda\lambda$ 5 153·235 and 4 651·124 have been used as standards. The measured lines include the super-quintet $5s\ {}^5S$–$5p\ {}^5P$ of Br II. The intervals of the $5p\ {}^5P$ level are thus determined accurately. AUTHOR.

1824. Spectra of mercury at high vapour pressure in condenser discharge. T. HARADA AND R. MIYASAKA. *Proc. Phys.-Math. Soc., Japan*, **23**, *pp.* 370–376, *May*, 1941.—The condenser discharge spectra of Hg at high vapour pressure is studied up to about 15 atm. and 3 000 Å. The lines of the series ${}^3P$-${}^3D$ become very broad and continuous as compared with the other lines due to the high sensitivity of the ${}^3D$ terms to Stark effect. At 15 atm. all the lines become absorption lines or disappear in the continuous background except probably the line 3 984 ($5d^9 6s^{2\,2}D_{2\frac{1}{2}}$–$5d^{10} 6p\,{}^2P^0_{1\frac{1}{2}}$) which remains relatively sharp up to the highest pressure. The energy distribution in the visible range displays the existence of very broad emission bands near the atomic lines, showing that the quantum states are not completely destroyed in the discharge. AUTHORS.

1825. Electrode concentrations and total intensity of spectral lines. H. HEMMENDINGER. *J. Opt. Soc. Amer.*, **31**, *pp.* 150–156, *Feb.*, 1941.—The influence of self-absorption and self-reversal on the total intensity of the line is discussed, and a method is developed for estimating and eliminating these effects by comparing the intensities of a variety of lines of the same element. The corrected intensities obtained in this way are considered as functions of the abundance ratio in the case of a mixture of Fe and Ti. R. P.

1826. Clean-up of mercury vapour in discharges through H, He and N. O. S. DUFFENDACK, R. A. WOLFE AND F. LEDERER. *J. Opt. Soc. Amer.*, **31**, *pp.* 174–176, *Feb.*, 1941.—If a discharge is passed through H, with traces of Hg, the intensity of the Hg lines diminishes considerably during the first few minutes owing to clean-up. This effect is due to the formation of mercury hydride on the walls of the vessel. There is much less clean-up in either He or N. It is suggested that errors can be caused by this in analysing mixtures of H and Hg, unless the measurements are made in absorption spectra, or the sample mixed with a carrier gas such as He or N. R. P.

1827. Infra-red absorption spectra of AgCl crystals with addition of foreign complex ions. F. W. ACKERMANN. *Ann. Phys., Lpz.*, **37**, 5–6, *pp.* 442–452, 1940. *In German.*—Investigation of the infra-red absorption of AgCl crystals containing the complex ions: SO_4, CrO_4, Cr_2O_7, OCN, CN, NO_3, NO_2, and WO_4. The crystals are grown from the melt, to which the corresponding silver salt is added, and then rolled into leaves of about 25 μ thickness. The complex ions produce characteristic absorption bands between 3·4 and 16 μ. At low temperatures all crystals exhibit strong fluorescence. AgCl itself shows a broad emission in the visible with max. in the green. The anions produce characteristic colours by extinguishing parts of this emission spectrum. A. VON H.

1828. Displacement of absorption lines in solids by pressure and temperature. H. K. PAETZOLD. *Ann. Phys., Lpz.*, **37**, 5–6, *pp.* 470–476, 1940. *In German.*—The displacement of absorption lines in ruby, alexandrit, xenotim and praseodymium nitrate; by temperature change and by pressure up to 1 000 atm. has been measured. In ruby at 80°K. a pressure of 1 000 atm. produces the same red shift as a temperature increase from 80°K. to 100°K. In alexandrit the same pressure corresponds to a temperature change from 80°K. to 115°K. In praseodymium nitrate a line was investigated which moves with increasing temperature to shorter wavelength. Pressure, on the other hand, produced a red shift again. This fact can be understood by considering the influence of the electric field produced by the temperature vibrations. Only the fraction which is independent of time corresponds to the pressure effect, while in the Pr^{3+} lines the action of the variable field is dominant. A. VON H.

1829. Absorption spectra of haemoglobin in solution and in red blood corpuscles. D. KEILIN AND E. F. HARTREE. *Nature, Lond.*, **148,** *pp.* 75–77, *July* 19, 1941.

1830. Zeeman-effect data and further classification of the first spark spectrum of Ce II. G. R. HARRISON, W. E. ALBERTSON AND N. F. HOSFORD. *J. Opt. Soc. Amer.*, **31,** *pp.* 439–448, *June*, 1941.—The light emitted by Ce atoms in magnetic fields up to 96 400 oersteds was photographed at high spectrographic resolution over the range 2 500 to 7 000 Å. Interpretable Zeeman patterns of 427 Ce II lines were reduced, and from them *g* and *J* values were determined for 280 levels. These data were used to check and extend the classification of Ce II, in which 3 600 lines are now assigned to transitions between pairs of 316 levels. The energy system of Ce II consists of 2 groups of levels which have not yet been connected. Interactions among these levels are strong, and assignment of individual quantum numbers will probably have little significance. Data are now available for complete tests of the *g* sum rule in a number of cases. It is found to be exact in cases where all perturbing terms are known. AUTHORS.

1831. Stark effect on H_2 molecule. I. G. HAYAKAWA. *Proc. Phys.-Math. Soc., Japan*, **23,** *pp.* 318–335, *April*, 1941.—The Stark effect on the H_2-spectrum in the red and yellow region was measured using dispersion about 8·1 Å/mm. With a field strength 208 000 V/cm. better resolution of components was obtained than in former investigations. The results were compared with the theoretical displacements roughly calculated as due to the mutual influences among neighbouring terms, specially for antisymmetrical lines of $\alpha(0, 0)$ band. AUTHOR.

1832. Investigations into the Raman effect of alum crystals. G. LEIBFRIED. *Ann. Phys., Lpz.*, **37,** 8, *pp.* 628–630, 1940. *In German.*—The Raman spectrum of a large crystal of K-Al alum is excited by Hg λ 2 537, the unmodified line is suppressed by a Hg resonance filter. The lines 456, 617, 974, 990, 1 095, 1 128 cm.$^{-1}$ agree with previous observations and are ascribed to vibrations of SO_4. They differ from the known lines of this ion by the fact that the symmetric vibrations 981 appear doubled. Two broad bands at 3 392 and 3 550 are due to H_2O. A series of new lines of l.f. 78, 118, 157, 187, 322 cm.$^{-1}$ are ascribed to lattice vibrations. The existence of these vibrations accounts for the satellites observed in the line spectra of the alums. M. S. V.

1833. Note on the Raman lines of cane sugar crystals. G. LEIBFRIED. *Ann. Phys., Lpz.*, **37,** 8, *pp.* 631–637, 1940. *In German.*—In contrast with the results on alum crystals Raman spectrum of cane sugar crystals show no lines of l.f., indicating that the lattice vibrations have frequencies below 30 cm^{-1}. The observed lines at 835, 920/60, 1 040, 1 145/75, 1 250, 1 370, 1 470, 2 730 cm.$^{-1}$ deviate very little from those found in sugar solutions and in glycerin. M. S. V.

1834. Temperature variation of the Raman frequency of diamond. P. G. N. NAYAR. *Proc. Indian Acad. Sci. A*, **13,** *pp.* 284–290, *April*, 1941.—The frequency of the Raman line of diamond has been studied at 8 different temperatures and found to vary from 1333·8 cm.^{1} at — 190°C. to 1 316·4 860°C. From the thermodynamical relation between the thermal expansion of the crystal and the variation of the characteristic frequency it has been found that the change observed is greater than that expected. In this connection the part played by the oscillation of the lattice in the conversion of diamond to graphite at 1 800° is discussed. AUTHOR.

1835. Raman spectrum and sp. ht. of crystalline. R. NORRIS. *Proc. Indian Acad. Sci. A*, **13,** *pp.* 291–299, *April*, 1941.—The Raman spectra of a single crystal of S are studied with special reference to their behaviour in different orientations of the crystal and with the incident light in different states of polarization. The presence of an intense l.f. line with a frequency shift of 50 wave numbers is reported. As indicated by the behaviour of the l.f. lines 50 and 85 in different orientations of the crystals, and with the incident light in different states of polarization, they are assigned respectively to the tilting and rotational oscillations of the S molecule. The sp. ht. of S is represented as the sum of 3 expressions. The first is a Debye function for the continuous acoustic waves, the second represents the sum of Einstein functions for the rotational oscillations of the S_8 molecule, and the third represents the sum of the Einstein functions for its internal vibrations. The values thus calculated are found to agree with the observed values. AUTHOR.

1836. Intensities of the Raman lines in CO_2. N. S. N. NATH AND E. V. CHALAM. *Proc. Indian Acad. Sci. A*, **13,** *pp.* 339–351, *May*, 1941.—The polarizability of a molecule is assumed to be made up of the bond polarizabilities as functions of the inter-nuclear distances. It is pointed out that certain normal co-ordinates could be quadratic functions of some of the variations in the inter-nuclear distances, which fact accounts for the appearance of overtone Raman lines, assuming only first-order variations in the bond polarizabilities. AUTHORS.

1837. Interference spectroscopy. I. K. W. MEISSNER. *J. Opt. Soc. Amer.*, **31,** *pp.* 405–427, *June*, 1941.—The theory of the Fabry-Perot parallel-plate étalon is discussed in detail, and a least-squares method is derived for calculating the fractional part of the central order. Expressions are derived for the intensity distribution in the interference patterns, and the use of the étalon as a spectroscope is described and its resolving power calculated. Crossing the instrument with a dispersing apparatus is discussed in connection with hyperfine-structure work and the measurement of small wavelength differences and of secondary wavelength standards. Corrections are given to the observed wavelengths to allow for phase change at reflection and for atmospheric dispersion. A. HU.

1838. Arc employing high streaming velocity for spectrochemistry. M. F. HASLER. *J. Opt. Soc. Amer.*, **31,** *pp.* 140–145, *Feb.*, 1941.—An arc source is developed which combines many of the advantages of the d.c. arc, the h.v. spark and the a.c. arc. It consists of a d.c. arc in which the sample is mixed with, or surrounded by, a powdered carrier which evaporates rapidly and carries the sample bodily into the arc. In 4 secs. the arc can deal with 50–100 mg. of material at 10 A. The region of the arc from which the spectrum should best be obtained is different for a solid metal sample from that for a powdered sample. In calibrating the spectrometer, blackening curves for the photographic plate should be obtained throughout the spectrum and not only at one wavelength. R. P.

1839. Temperatures in spectroscopic sources used in analytical work. O. S. DUFFENDACK AND J. M. LARUE. *J. Opt. Soc. Amer.*, **31,** *pp.* 146–149, *Feb.*, 1941.—Observations were made on the intensity distribution of the rotation bands of CN from an arc. Although the molecules in the arc are not in thermal equilibrium, the variation of intensity through the rotation band is such as would be obtained in thermal equilibrium at a certain temperature. This temperature is between 6 000° and 8 000°K. and varies very little with the current in the arc or the gap between the electrodes. R. P.

***1840. Vacuum spark gap with rapid spark sequences,** K. RAWER. *Phys. Z.*, **41,** *pp.* 410–412, 1940. *In German.*—A spark gap which minimizes the effect of the burning away of the electrodes is described. This burning away results in continual flickering and irregular intensity of the spark. The edge of a rotating Al disc is used as one electrode and a W pin perpendicular to the plane of the disc is used as the other. During a spark sequence, because of the high m.p. of W, it is essentially only the Al electrode which burns away and the effect is spread uniformly over the entire circumference of the disc. The disc and W pin are enclosed in an evacuated chamber and the disc is rotated by means of an induction motor arrangement. A rev. counter built in the evacuated chamber and coupled to a l.f. amplifier serves to measure the angular velocity of the disc. A 50 c./s. h.v. oil transformer is used to charge a battery of Leyden jars which then discharges across the spark gap. A voltage of 30 kV produced a spark length of 0·6 mm. Precautions are taken to shield all conductors from the strong h.f. current produced by the spark discharge. The spark chamber is cemented to an evacuated quartz monochromator to which is cemented also an evacuated glass chamber containing an Sb-Bi thermo-element. Thus the light path from the spark to the thermo-element is entirely *in vacuo*. In this manner an intense line spectrum of ultra-violet wavelengths is obtained. Lines of the spectrum of Al as low as 1 671 Å were determined. It is found that filling the chamber with N gives a more intense and more reproducible light source for the ultra-violet. W. W. W.

***1841. Properties and use of h.f. spark discharge for local micro-analysis.** W. M. MURRAY, JR., B. GETTYS AND S. E. Q. ASHLEY. *J. Opt. Soc. Amer.*, **31,** *pp.* 433–438, *June*, 1941.—Small areas of a metallic specimen are examined spectrochemically by using a localized spark in conjunction with a moving spectrograph plate. An oscillatory 2 000 V spark with a peak current of 15 A is guided over the surface of a moving specimen whilst the photographic plate on which the spectrum is recorded is moved parallel to the slit. This results in a continuously changing spectrum in which the lines vary in intensity over their lengths according to changes in the local composition along the path of the spark. Full details of the apparatus are given and the question of the excitation levels of the spectra produced is discussed. High sensitivity and high localization are mutually exclusive, but a satisfactory compromise can usually be arranged. A. HU.

***1842. New glass and quartz glass spectrograph as a substitute for large grating instruments.** W. STEUBING. *Z. techn. Phys.*, **21,** 11, *pp.* 243–246,

1940. *In German.*—The details of 2 large prism spectrographs are given. All optical parts are of exceptionally good quality so that the resolving power and dispersion come close to that of large grating spectrographs. G. H. D.

✱ **1843. Large recording spectrograph for the infra-red to 15μ.** E. D. McAlister, G. L. Matheson and W. J. Sweeney. *Rev. Sci. Instrum.*, **12,** *pp.* 314–319, *June*, 1941.—When a resolving power equivalent to the theoretical limit of a large prism (varying from 1 cm.$^{-1}$ at 6μ to 0·3 cm.$^{-1}$ at 15μ) was obtained with the present instrument its scope of usefulness was found to be greatly increased. The improvements in detail necessary to achieve this practical balance between prism size, aperture and sensitivity of detection, are described. Authors.

TRANSMISSION.

1844. Method for the determination of the velocity of light using the Kerr effect and a photocell as phase-dependent rectifier. A. Hüttel. *Ann. Phys., Lpz.*, **37,** 5–6, *pp.* 365–401, 1940. *In German.*—Repetition of a measurement of the velocity of light by the Karolus-Mittelstädt method, according to Anderson's technique. The result is $c = 299\,768 \pm 10$ km./sec. in agreement with the latter's value. The modulation frequency was 12 Mc./s., the light path 80 m. The driving voltage of the Kerr cell was automatically kept constant, as well as its temperature. Corrections were also made for the transit time of electrons in the photocell. M. S. V.

VISION.

1845. Energy at the threshold of vision. S. Hecht, S. Shlaer and M. H. Pirenne. *Science*, **93,** *pp.* 585–587, *June* 20, 1941.—A new determination is reported of the energy required to produce a just detectable flash of light. The test object was circular, subtending 10′ of arc, illuminated by light of wavelength 510 mμ and focused on the retina 20° off the axis on the temporal side. The flash lasted for 1 msec. and the energy was measured with a thermopile and Paschen galvanometer. The results showed that the min. energy necessary for vision ranged between 2·2 and $5{\cdot}7 \times 10^{-10}$ ergs at the cornea. These energies represent between 58 and 148 quanta. After allowance for loss of light in the ocular media and for the absorption of visual purple, the number of quanta actually absorbed by visual purple is between 5 and 14. An alternative check was made by varying the intensity and recording the frequency with which the flash was seen. From probability considerations it is deduced from the latter experiments that between 5 and 7 quanta are necessary to produce a visual effect. W. D. W.

X-RAYS.

1846. Investigations in the azimuthal intensity distribution of Röntgen rays. R. Honerjäger. *Ann. Phys., Lpz.*, **38,** 1, *pp.* 33–45, 1940. *In German.*—The azimuthal intensity distribution of continuous X-rays from thin Al and Ni foils was measured for a tube voltage of 34 kV. The apparatus allows measurements at all angles from 0° to 180° and the intensities were measured with a tube counter. The foils were obtained by evaporation from celluloid films. The experimental curves for Al foils of thickness 6 000, 350 and 100 Å for X-rays in the neighbourhood of the absorption limit are closer to the theoretical curves calculated by Scherzer the smaller the thickness. Discrepancies persist only in the vicinity of 0°, which is presumably accounted for by insufficient monochromaticity. Ni foils of thickness 150 Å give the same distribution curve as Al foils of 350 Å. Since these are equivalent as regards cathode-ray diffusion, the conclusion is drawn that the intensity distribution for the absorption limit is independent of the atomic number. M. S. V.

1847. Modified reflection of X-rays: naphthalene. S. Bhagavantam and J. Bhimasenachar. *Proc. Indian Acad. Sci. A*, **13,** *pp.* 266–268, *April*, 1941.—Modified X-ray reflections due to (001), (002) and (20$\bar{1}$) planes of naphthalene have been recorded only when the crystal setting is very near that of the critical setting in each case. For orientations which differ appreciably from the above settings, the intensity of the modified spots appears to be very low. Authors.

1848. Effect of temperature variation and electric field on X-ray intensity reflected from Rochelle salt crystal. I. Temperature effect. S. Miyake. *Proc. Phys.-Math. Soc., Japan*, **23,** *pp.* 378–395, *May*, 1941.—The X-ray reflecting intensities from a number of net planes of the Rochelle salt are measured in detail by means of the double-crystal ionization spectrometer at a temperature range of 15°–30°C. including the upper Curie point (ca. 24°C.). As a result, the existence of a definite temperature effect on the reflecting intensity has been confirmed and this effect is to be explained as due to the variation of the secondary structure of this crystal in the neighbourhood of its Curie point. Author.

1849. Variation of the atomic-structure factor with wavelength in the region of anomalous dispersion. S. Yoshida. *Sci. Pap. Inst. Phys. Chem. Res., Tokyo, No.* 1016, *pp.* 263–271, *April*, 1941.—The intensity distribution with wavelength of continuous X-rays reflected by various types of crystal was investigated qualitatively in the immediate neighbourhood of an absorption limit of a constituent atom of the crystal. In the cases of molybdenite, quartz and sodium chlorate, there is a considerable increase of reflection on the short-wavelength side of the absorption limit, contrary to expectation. The effect of grinding on the reflection was also examined in these cases. The experimental results are compared with the curve of variation of atomic-structure factor with wavelength in the region of anomalous dispersion calculated by the dispersion theory. In the case of mosaic crystals the observed curve deviates from the theoretical owing to the large true absorption on the short-wavelength side of the limit, but the agreement is closer, though not entirely satisfactory, for perfect crystals, such as molybdenite. A. J. M.

1850. *K*-absorption edge of Fe in various chemical states. S. Yoshida. *Sci. Pap. Inst. Phys. Chem. Res., Tokyo, No.* 1017, *pp.* 272–286, *April*, 1941.—The *K*-absorption edge and the $K\beta_5$ emission band of Fe in various chemical states have been investigated. The main edges of the pure metal and alloys have wide energy steps. α-Fe and γ-type alloys of Fe show different fine structures of the main edge. The $K\beta_5$ band of metallic Fe is asymmetrical and its total energy-breadth is $7{\cdot}1 \pm 2$ eV. The main edges of ionic compounds of Fe are not step-like, and are comparatively narrow in energy-breadth. The ferrous, ferric, and cyanide complexes have different fine structures of the absorption edges, but there is little definite difference within these groups. A. J. M.

1851. Detailed analysis of the gold *L* spectrum. E. A. Woodall. *Phil. Mag.*, **32**, *pp.* 1–32, *July*, 1941.—Constructional and operational details are given of a vacuum spectrograph for working at 2 different distances. The X-ray spectrum of Au has been measured and 30 diagram lines and several spark lines, measured relative to the K_α lines of Mo, Sr, As, Zn and Cu, are listed. Errors inherent in the method are discussed. The mean spin doublet distance $L_{II} - L_{III} = 133{\cdot}63$, but the values of the differences $L_I - L_{III}$ and $L_I - L_{II}$ do not agree so well, as is to be expected from the fact that these involve quadrupole lines which are much weaker. A table of energy levels for Au has been calculated from L_I onwards. W. R. A.

1852. Production of characteristic X-rays by deuteron bombardment. J. M. Cork. *Phys. Rev.*, **59**, *pp.* 957–959, *June* 15, 1941.—It is shown by a photographic method that for deuterons of 10 eMV, characteristic *K* radiation is emitted from targets of atomic number 38 or less. Because of absorption, the intensity appears to have a max. for elements of atomic number about 28. Similarly, *L* radiation is observed for the heavier elements with a max. in the neighbourhood of atomic number 64. For a Cu target the yield of X-rays is observed as a function of the exciting energy. The results are compared with the theoretical calculations of Henneberg. Author.

1853. Focusing X-ray monochromators. C. S. Smith. *Rev. Sci. Instrum.*, **12**, *pp.* 312–314, *June*, 1941.—Notes on the preparation of rocksalt crystals are presented. Arrangements for using these monochromators in the production of powder patterns are described. Author.

1854. Lead equivalent of Tl for X-rays. R. Jaeger. *Phys. Z.*, **41**, *pp.* 398–399, *Sept.*, 1940. *In German.*—The absorbing power of a Tl foil was compared with that of Pb for X-rays of such qualities that they were reduced to $\frac{1}{2}$ value by 0·25, 1·54, and 1·85 mm. of Cu. For the softest rays the screening power of Tl *v.* Pb increases with increasing homogeneity of the radiation. This effect is less marked for the harder rays, which can be explained by the relative positions of the *K*-absorption edges. W. W. W.

1855. X-ray analysis of protein denaturation. M. Spiegel-Adolf and G. C. Henny. *J. Phys. Chem.*, **45**, *pp.* 931–937, *June*, 1941.—X-ray diffraction patterns of heat-denatured serum albumin show a sharpening of the backbone reflection (4·5 Å) and the occurrence of 3 outer rings with spacings 3·49 Å to 4·02 Å. X-ray diffraction patterns of ultraviolet-light-denatured serum albumin show practically no differences in the patterns from the genuine samples. Upon treatment of the heat-denatured serum albumin, which usually brings forth reversal of the heat denaturation, the characteristic changes in the X-ray diffraction pattern disappear. Authors.

HEAT.

CALORIMETRY.

1856. Temperature correction methods in calorimetry. A. King and H. Grover. *J. Appl. Phys.*, **12**, *pp.* 557–568, *July*, 1941.—There are 2 fundamentally different methods of correcting calorimetric data for heat losses to surroundings. The first method, applicable only to experiments in which the supply of heat to the calorimeter can be neglected after a certain time, uses the after-period cooling curve together with a similar curve from data taken before the heat supply started, to evaluate appropriate correction terms. A second method is needed in such experiments as the measurement of sp. ht. when it is not safe to neglect the heat supplied by the hot body even after a very long time. In this case there is no after-period cooling curve and additional assumptions concerning the heat exchange between the calorimeter and the hot body within it must afford the needed information. The assumptions originally suggested by Rowland are re-examined. A better method is developed and a simple approximation of it is suggested. AUTHORS.

*1857. **Specific heat of lac.** G. N. BHATTACHARYA. *Indian J. Phys.*, **14**, *pp.* 415–422, *Dec.*, 1940.—Sp. ht. of different varieties of lac and lac constituents have been determined with a vacuum calorimeter. The constructional details of the calorimeter are described. The first series of experiments show that the sp. ht. of shellac practically remains constant over the temperature range of 10°C. to 40°C. and the value obtained is between 0·36 and 0·38 cal./g./deg.C. Higher values are obtained at higher temperatures. Seedlac has a slightly higher value of sp. ht. than shellac. Heat-hardened lac has a lower value of sp. ht. owing to the elimination of water during the hardening process. Lac begins to absorb heat of fusion at 40°C. AUTHOR.

See also Abstracts 1835, 1875.

CONDUCTION.

1858. **Thermal conductivity of Indian timbers. I. Variation of conductivity with density in the air-dry condition at ordinary temperature.** D. NARAYANAMURTI AND V. RANGANATHAN. *Proc. Indian Acad. Sci. A*, **13**, *pp.* 300–315, *April*, 1941.—Accurate data on the thermal conductivity of 56 species of Indian timbers, varying in density from 265 kg./m.^{3} to 1 310 kg./m.^{3} in the air-dry condition at about 20°C. are reported. The influence of convection and radiation on the conductivity of wood is discussed and the results compared with those of other investigators. AUTHORS.

1859. **Thermal conductivities of W and Mo at incandescent temperatures.** R. H. OSBORN. *J. Opt. Soc. Amer.*, **31**, *pp.* 428–432, *June*, 1941.—Using an optical pyrometer method, the thermal conductivity of W is found to vary linearly from 1·170 W/(cm.^{2} deg. K./cm.) at 1 100°K. to 1·026 W/(cm.^{2} deg. K./cm.) at 2 000°K. Similarly, the thermal conductivity of Mo is found to vary linearly from 1·083 W/(cm.^{2} deg. K./cm.) at 1 200°K. to 0·666 W/(cm.^{2} deg. K./cm.) at 1 900°K. Spectrographic analysis indicated only traces of impurities in samples of the 2 metals used in the investigation. AUTHOR.

1860. **Influence of magnetic fields on the heat conduction of alkali vapour.** D. SICHTIG. *Ann. Phys., Lpz.*, **38**, 4, *pp.* 274–282, 1940. *In German.*—It is shown experimentally that for fields up to 5 300 gauss there is no heat conduction in Cs vapour within experimental error. M. S. V.

1861. **Electric and thermal resistance of Be crystals in transverse magnetic fields.** E. GRÜNEISEN AND H. D. ERFLING. *Ann. Phys., Lpz.*, **38**, 5, *pp.* 399–420, 1940. *In German.*—The change of electrical and thermal resistance, Δ_ϱ and Δ_w, of Be crystals, with the current at right angles to the hexagonal axis, by transversal magnetic fields up to 12 000 oersted, was measured at − 183°, − 195° and − 253°C. The effect of the field is strongly anisotropic and shows 2-fold symmetry with respect to the current direction and mirror symmetry with respect to the plane determined by the hexagonal axis (z) and the current direction. The position of the binary axis (x) relative to the current direction is immaterial. The effect of the field is weakest when H is perpendicular to z. Its max. effect for weak fields is for H parallel to z for stronger fields there are 2 maxima at angles ± 20°–30° with the principal axis. The change of electrical resistance Δ_ϱ is proportional to H for small fields but never becomes proportional to H^2 for high fields. The Kahler-Bethe rule holds approximately. The change of thermal resistance Δ_w has similar anisotropy and behaviour as the electrical. The thermal resistance does not approach a constant value in the range of magnetic field and temperature investigated. The increase of thermal resistance by a magnetic field is considerably smaller than the increase of electrical resistance. M. S. V.

1862. **General relations governing the heat conductivity of various kinds of substances and different states of aggregation.** A. EUCKEN. *Forsch. IngWes.*, **11**, *pp.* 6–20, *Jan.–Feb.*, 1940. *In German.*—The author indicates ways of determining approx. thermal conductivity coefficients for technically important materials. The heat conductivity of gases may be calculated from viscosity and sp. ht. Its value may be estimated with sufficient accuracy for practical purposes for a liquid, if it is known for a liquid chemically and physically closely related to the one in question. An exact method for calculating the conductivity of non-metallic solids does not exist. But some results of the investigations, e.g. the considerable differences existing between the conductivities of crystallized and amorphous substances, may prove to be of practical importance. The thermal conductivity of metals may be computed from the measured values of electrical conductivity by applying the law of Wiedemann-Franz-Lorenz. A correction term used in connection with this law allowed of computing the heat conductivity of certain alloys with an accuracy of a few per cent. R. N.

1863. Non-stationary method for determining the thermal conductivity of liquids. J. Weishaupt. *Forsch. IngWes.*, **11,** *pp.* 20–34, *Jan.–Feb.*, 1940. *In German.*—The method developed and theoretically proved by Pfriem consists in examining the cylindrical temperature field formed by an electrically heated wire within the liquid to be investigated. The temperature is a function of time, distance and conductivity. The change of temperature with time and the heat input permit of determining the conductivity. The author investigates the conditions under which this method can be developed to the best advantage for practical uses. The method is best suited for electrically non-conducting liquids and for granulated or solidified substances. Semi-conductors and weak electrolytes may be investigated according to this method if special precautions are taken. R. N.

See also Abstract 1699.

FUSION AND SOLIDIFICATION.

1864. Melting point of Te. F. C. Kracek. *J. Amer. Chem. Soc.*, **63,** *pp.* 1989–1990, *July*, 1941.

TEMPERATURE.

1865. Production of liquid He by the Kapitza method. C. T. Lane. *Rev. Sci. Instrum.*, **12,** *pp.* 326–331, *June*, 1941.—A description of the design and operation of the low-temperature laboratory recently built at Yale University is given. The equipment consists of a Kapitza-type He liquefier and associated He gas storage and circulation systems. The design and performance of the expansion engine of the liquefier is discussed. The size and arrangement of the heat exchanger coils are discussed and a table of tube sizes given. The layout of the He distribution and purifying system is given, including a description of the type and performance of the compressor and vacuum pumps. Author.

THERMODYNAMICS.

1866. Notation for derivatives of the 2 types of line integral in thermodynamics. G. Tunell. *J. Chem. Phys.*, **9,** *pp.* 191–192, *Feb.*, 1941.—It is suggested that the symbol $(dz/dx)_y$ should be used in thermodynamics to denote the derivative of a line integral which depends on the path of integration (work or heat) if the line integral is taken along a line parallel to the y-axis in the xy plane. The reasons for this convention are given. R. P.

1867. Principles and aims of thermodynamic research. E. Schmidt. *Forsch. IngWes.*, **11,** *pp.* 1–6, *Jan.–Feb.*, 1940. *In German.*—A general progress review. R. N.

1868. The second virial coefficient of acetaldehyde. E. A. Alexander and J. D. Lambert. *Trans. Faraday Soc.*, **37,** *pp.* 421–426, *Aug.*, 1941. —The coefficient was measured and calculated from the Berthelot equation. There is a large discrepancy between the 2 values which may be accounted for in terms of a polymerization with a heat of 5·226 k.cal./mol. Authors.

1869. Equation of state of mixtures. V. Fischer. *Ann. Phys., Lpz.*, **38,** 1, *pp.* 26–32, 1940. *In German.*—An equation of state for mixtures is set up which for simple substances passes into that of Kammerlingh Onnes as a special case. Simplifications for gas mixtures at not too high pressures and not too small temperatures. Applications to mixtures of H, He and A and comparison with data of Gibby, Tanner, and Mason. Calculation of the mixture dilatations of the components of the mixture. M. S. V.

1870. Determination of critical temperature from index of refraction. S. W. Wan. *J. Phys. Chem.*, **45,** *pp.* 903–907, *June*, 1941.—A linear relation between critical temperature and mole refraction is derived. The relation is tested with 6 different types of organic compounds for which critical-temperature data are available ; the agreement between calculated and experimental critical temperatures is good. Author.

1871. Heat capacities and entropies of Al and Cu from 15° to 300°K. W. F. Giauque and P. F. Meads. *J. Amer. Chem. Soc.*, **63,** *pp.* 1897–1901, *July*, 1941.

1872. Heat Capacities and Entropies of Ag and Pb from 15° to 300°K. P. F. Meads, W. R. Forsythe and W. F. Giauque. *J. Amer. Chem. Soc.*, **63,** *pp.* 1902–1910, *July*, 1941.

1873. Heat capacity and density of aqueous solutions of KIO_3, $KHSO_4$, HIO_3 and H_2SO_4 at 25°C. M. Randall and M. D. Taylor. *J. Phys. Chem.*, **45,** *pp.* 959–967, *June*, 1941.

1874. Thermodynamic study of bivalent metal halides in aqueous solution. VIII. The activity coefficient of ferrous chloride. R. H. Stokes and R. A. Robinson. *Trans. Faraday Soc.*, **37,** *pp.* 419–421, *Aug.*, 1941.

1875. Specific heats, enthalpy and entropy, of the newer cooling agents in the gaseous state at low pressures. I. CH_2Cl_2 and CF_2Cl_2. E. Justi and F. Langer. *Z. techn. Phys.*, **21,** 9, *pp.* 189–195, 1940. *In German.*—In the absence of thermal data for the new cooling agents, methylenchloride (CH_2Cl_2) and dichlorodifluoromethane (CF_2Cl_2, or " freon 12 "), the sp. ht. of these gases as functions of temperature have been calculated statistically for the ideal state, using available spectroscopic data for vibrational frequencies. From these data entropy, energy and enthalpy, have been determined. Real-gas corrections are made, using Berthelot's equation of state and critical data. From these calculations the true and mean ratios of sp. hts are found. Values of the several quantities are given for CF_2Cl_2 from − 100°C. to 200°C. and for CH_2Cl_2 from − 50° to 150°C. in steps of 25 deg. Comparisons are made with meagre experimental data available. G. H. D.

1876. Numerical calculation of power variation with altitude in a naturally aspirated engine by means of *J. S.* diagrams. K. Tanaka, O. Tamura and O. Konisi. *Rep. Aero. Res. Inst. Tokyo, No.* 204, *pp.* 3–31, *Feb.*, 1941.—The variation in power of a naturally aspirated engine with altitude from sea-level to 15 000 m. has been calculated, changes in the sp. ht. of air and fuel vapour with temperature, and variation in the degree of dissociation of the fuel gas with temperature and pressure, being taken into account. A. J. M.

1877. Simplified solution for 4-component Jaenecke phase diagrams. H. Buraus. *J. Phys. Chem.*, **45**, *pp.* 968–977, *June*, 1941.—A simple analytical method of solving 4-component reciprocal salt-pair phase-rule problems is derived by geometric means from fundamental considerations of a Jaenecke diagram. The unique properties of a diagonal in a 4-component Jaenecke phase diagram are discussed. Author.

VAPORIZATION AND CONDENSATION.

1878. Revised standard method of test for distillation of liquid asphaltic bitumen (tentative). *J. Inst. Petrol.*, **27**, *pp.* 226–229, *June*, 1941.

1879. Production of clouds in gases saturated with water vapour by removal of heat from the vapour by conduction. F. Trey. *Phys. Z.*, **41**, *pp.* 415–418, 1940. *In German.*—An attempt is made to develop a cloud chamber which will maintain a supersaturated condition of the vapour for more than the 2 sec. now possible, and which may be kept in continuous operation. It is pointed out that cloud formation is in no way dependent upon expansion, that being merely a means of lowering temperature. A glass tube was filled with gases saturated with water vapour and its temperature lowered by playing upon it CO_2 which had been allowed to expand. It was possible to produce a cloud which lasted $\frac{1}{2}$ min. when the temperature of the vapour was initially 20°C. and the temperature of the cooling stream 5°C. W. W. W.

ACOUSTICS.

1880. Electro-acoustic sound-pressure measurements in practice. M. Gosewinkel and F. Spandöck. *Arch. techn. Messen, No.* 104, *V*53–5, *Feb.*, 1940. *In German.*—From measurements of sound pressure the other quantities of the sound field may be computed if the type of wave is known. The sound-pressure meter usually consists of a condenser microphone, an amplifier and an indicating instrument. Calibrating curves, different for pressure-chamber or open-field measurements, are required. General disturbances, influence of the arrangement in space and accuracy of measurements, are discussed. With regard to errors due to the sound field an accuracy of 10–20% is sufficient for practical purposes. A Bibliography of 37 publications is given. R. N.

1881. Acoustical refraction and total reflection. O. von Schmidt and A. Kling. *Phys. Z.*, **41**, *pp.* 407–409, 1940. *In German.*—The main objective was to obtain experimental evidence on the influence upon the wave fronts of compressional waves of a continuous change in speed or acoustical density. The "Schlieren" method of photography was applied to projectiles fired obliquely upward from a rifle. The angle of elevation was so chosen as to cause the upper branch of the bow wave to be horizontal and to move vertically upward. The trajectories of the elongated bullets passed through the cylindrical columns of hot air rising above either 1 candle flame or 2 candle flames in succession. It was found that bow waves occur for the continuous transition from one speed of wave propagation to another, that secondary bow waves exist, that when plane waves experience total reflection at the hot air the waves are damped across the right section of the beam. This fact is interpreted as the physical cause of total reflection. W. W. W.

1882. The sensitive flame. E. N. da C. Andrade. *Proc. Phys. Soc., Lond.*, **53**, *pp.* 329–355, *July*, 1941.—In a description of experiments made to explain the sensitive flame, the working of a jet of water-into-water is chosen. The jet passed through a circular orifice and was coloured with Kiton red; it was very sensitive to sound and its response depended on the velocity of efflux and the frequency and intensity of the sound. The effect of the vibrations is to cause a sinusoidal disturbance which increases in amplitude until it disengages alternate vortices to either side, the series differing in certain respects from a Karman "street." Increased amplitude of the sound sets up forking of the jet. The sharp response of the jet to particular frequencies is due to vibration of the supporting structure, the tube which carries the orifice, and the floor, walls and air of the room. All the effects are caused by the transverse relative motion of orifice and surrounding fluid. The water jet or flame has no selective response in itself. Using a hydromagnetic analogy in which lines of magnetic force correspond to lines of flow of fluid, observations were made on strong linear currents arranged initially in 2 parallel sine curves, and it is concluded that the action of the parallel vortex sheets on one another is sufficient to explain the manner in which the growing instability of the actual jet develops from a sine wave. The condition for sensitiveness is high vorticity at the orifice dying off rapidly. The paper, which records the 25th Guthrie lecture, is well illustrated with photographs. G. E. A.

1883. Negative characteristics of the reed. J. Zahradniček and R. Nespor. *Phys. Z.*, **41,** *pp.* 419–421, 1940. *In German.*—The conditions for the negative characteristic ($dE/di < O$) of the electric arc are the same as those required for the emission of undamped electromagnetic waves by the arc. By analogy a reed set into vibration by a constant pressure and emitting undamped vibrations will have a negative characteristic. Thus, if p is the exciting pressure, j the volume velocity, i.e. dV/dt, where V is the volume of the reed chamber, then $dp/dj < O$. Curves indicating this relation are plotted for organ reeds. Other examples of negative characteristics : clock pendulum, metronome, the breathing of a person at ease. W. W. W.

1884. Dynamics of the pianoforte string and the hammer. IV. Study of duration of impact. V. Some special theories. M. Ghosh. *Indian J. Phys.*, **14,** *pp.* 475–497, *Dec.*, 1940.—Expressions for the duration of contact when the hammer strikes at different points of a finite string are worked out. The comparison of the theoretical values with those obtained experimentally by different authors is made graphically, and remarkable agreement is found in each case. It is found from theory that the duration of contact changes discontinuously with distance, and for the higher values of the mass-ratio the curve shifts towards the greater values of the duration. The variation of the duration of contact with different values of the elastic constant of the hammer for a given striking distance, as obtained from the theory, is also compared graphically with that obtained experimentally.—The approximate conditions necessary to reduce the general theory [Abstr. 1233 (1940)] to special cases are discussed. The case of the hard hammer is obtained by considering the elastic constant of the hammer as infinite. In order to explain the effect of the velocity of impact on duration of contact, the impact is considered in the light of Hertz's theory. In this case the pressure exerted by the hammer on the string becomes appreciable after a certain instant when it comes in contact and leaves the string long after the pressure falls to a very small value. Author.

1885. On the internal friction and the radiation damping of violins. E. Rohloff. *Ann. Phys., Lpz.*, **38,** 3, *pp.* 177–198, 1940. *In German.*—The damping of the fundamental was determined in vacuum and in air. Four violins of different quality were used: a modern, poor one; and 3 old good Italians, a Gaglianus, a Rogerius and a Stradivarius. On each string about one octave was investigated. The acoustic useful effect, depending on the difference between the decrements in air and vacuum, is about 30% higher for the Italian violins than for the poor ones, which is important for the rich tone of the former. There are well-determined regions with good acoustics, which for all the Italian violins fall within approx. the same range of frequency. Such regions agree with the loudness max. The distribution of the good acoustic regions along the frequency scale is also of significance for the tone. The decrement of the good Italian violins depends probably on the fact that their makers deliberately introduced stresses in the frames. Measurements on transversally stressed rods prove that their decrement is considerably higher than for unstressed rods. From this it follows that the wood in the violin should have the smallest possible inner friction in order to render possible such stresses as are important for the tone. The Italian makers presumably soaked the wood in a substance which decreased the damping due to wood. For the manufacture of good violins, wood with the smallest internal friction should be used. M. S. V.

1886. Ultrasonic absorption in water. F. E. Fox and G. D. Rock. *J. Acoust. Soc. Amer.*, **12,** *pp.* 505–510, *April*, 1941.—The principle of the method is based on the steady radiation pressure exerted on an obstacle placed in the sound beam at different distances from the source. Measurements were made over a frequency range from 7 to 50 Mc./s. using intensities less than 0·04 W/cm.^{2} The coefficient of absorption is given in terms of $2\,\alpha\nu^{-2} \times 10^{-17}$, where α is the amplitude attenuation factor per cm. and ν is the frequency. This quantity has an average of 43·1, and there is no evidence at any stage of a drop in the value with increasing frequency, as indicated by theory. G. E. A.

1887. Dispersion of ultrasonic velocity in organic liquids. K. G. Krishnan. *Proc. Indian Acad. Sci. A*, **13**, *pp.* 281–283, *April*, 1941.—Ultrasonic velocities are determined for 17 organic liquids employing 3 ranges of frequencies between 3 500 kc./s. and 8 000 kc./s. With the exception of acetic acid, there appears to be no evidence of dispersion in any of the liquids. Author.

1888. Ultrasonic velocity in N_2, NO and CO between 20° and 200°C., measured by a new method. D. Bender. *Ann. Phys., Lpz.*, **38**, 3, *pp.* 199–214, 1940. *In German.*—The temperature dependence of the velocity of sound at a frequency of 1 000 kc./s. is measured by a modification of the Pierce interferometer in which the piezo-quartz is mounted between 2 fixed reflectors. The quartz is coupled inductively to the driving oscillator and vibrates at temperatures up to 500°C., but above 200°C. the sound intensity is too weak to permit measurements. The results indicate that in N_2, CO and NO, the region of anomalous dispersion of the sound velocity is shifted with increasing temperature towards higher frequencies. M. S. V.

***1889. Electromagnetic sound generator for producing intense h.f. sound.** H. W. St. Clair. *Rev. Sci. Instrum.*, **12**, *pp.* 250–256, *May*, 1941.—It is known that suspended matter in the air can be flocculated and removed by h.f. waves. In this connection a new generator is described in which the vibrating element is a solid cylinder of duralumin, supported at its midsection and free to vibrate longitudinally. An exciting coil is wound round the central pole of a pot magnet and functions as the primary coil of a step-down transformer; a h.f. current flowing through it induces a much larger current in a driving ring which acts as a 1-turn secondary and is also part of the vibrator. The generator is a modification of the dynamic loud-speaker. Owing to the sharpness of resonance, the vibrator itself is designed to control the electrical oscillations which drive it and is thus made self-exciting. The oscillations are initiated by an electrostatic pick-up, and the construction and theory of the apparatus are fully described. The direct beam is painful to the ear and is capable of keeping a penny, lead shot, etc., suspended in mid-air. G. E. A.

1890. Absorbing power of an opening adjacent to an absorbent room. S. Kawashima. *J. Acoust. Soc. Amer.*, **12**, *pp.* 514–516, *April*, 1941.—A theoretical consideration of the absorbing power of openings, taking surrounding conditions into account, leads to the conclusion that, in determining the absorption coefficient of an opening, the size of the opening and the absorbing power of the adjoining room must be known. The value unity occurs only when the opening is very small or the total absorbing power is very large.

G. E. A.

1891. Applications of direct-reading pitch and intensity recorder. III–IV. J. Obata and R. Kobayashi. *Proc. Phys.-Math. Soc., Japan*, **23**, *pp.* 239–251, *March*, 1941.—[See Abstr. 259 (1941)].

1892. Intensive difference limen in audition. F. L. Dimmick and R. M. Olson. *J. Acoust. Soc. Amer.*, **12**, *pp.* 517–525, *April*, 1941.—The just noticeable difference (*J.N.D.*) in intensity between 2 sounds is measured for 5 observers at 5 frequencies from 128 to 1 000 and for different intensities at these frequencies. The average *J.N.D.* increment (ΔJ) in W/cm.^{2} × 10^{-16} is related to the intensity (J) by the equation: $\Delta J = 1{\cdot}5\, J^{0{\cdot}9}$. It is pointed out that averageing the ΔJ values is justified by the fact that no definite trend of those values appears to be dependent on frequency. The authors' results differ in this respect from those of previous investigators, and also as regards the absolute size of the increment. G. E. A.

1893. Elementary quantity of sound perception. S. Lifshitz. *J. Acoust. Soc. Amer.*, **12**, *pp.* 526–528, *April*, 1941.—A sound impulse of specific frequency is generated in a telephone and simultaneously a light impulse proceeds from a neon lamp. These impulses last for 0·75 sec. and follow again at intervals of 0·75 sec. When the sound is sufficiently loud, its duration and the time length of the light impulse are alike. Both impulses begin and end simultaneously. As the loudness of the sound impulse decreases, its beginning lags behind the light impulse whilst ending at the same instant, and with loudnesses close to the hearing threshold the sound impulse appears as a sound point at the end of the light impulse. For 10 observers the beginning of the sound lag took place at an average intensity of 14 db above threshold. From these and previous experiments [Abstr. 4116 (1939)] it is concluded that the element of sound perception is obtained when the loudness level is 2 db. G. E. A.

ELECTRICITY AND MAGNETISM.

CONDUCTION AND DISCHARGE IN GASES.

1894. Starting an electric spark by intense ionization of the sparking space. T. Shimizu and M. Hirata. *Sci. Pap. Inst. Phys. Chem. Res., Tokyo, No.* 1022, *pp.* 317–325, *May*, 1941.—An apparatus by which it is possible to start a spark at any definite time, and at a lower critical potential than normal, is described. The space through which the spark is to pass is highly ionized by a beam of cathode rays from a triode. The time lag is less than 10^{-7} sec., and the net lowering of the critical potential was about 30% of its normal value. The apparatus might be used as a relay, as a light source for instantaneous photography which is easy to control, and as a chronograph for the measurement of extremely short times.

A. J. M.

1895. Studies of a ring discharge. C. G. Smith. *Phys. Rev.*, **59,** *pp.* 997–1004, *June* 15, 1941.—A driving e.m.f. of 890 c./s. was employed to energize a ring discharge in mercury vapour in the pressure region near 2×10^{-4} mm. The ring was a secondary of 1 turn about a transformer core. E.m.f. per turn was usually near 5 V. Probe measurements revealed a true electronic temperature with values ranging up to about 300 000°K. at the peak of the wave of energization. Only 13% of the atoms were ionized at the max. of the cycle of inoization. The highest electronic temperatures were not found at the lowest pressures. At a given e.m.f. the rate of build-up of the field of ions and the electronic temperature was lower at lower pressures. The energization reached a peak near the end of a half-cycle of the input voltage even though the current started at zero voltage. Strong lines of Hg I–II–III together with faint lines of Hg IV were observed. The forbidden line 1^1S_0–2^3P_2 was definitely observed, and the forbidden line 1^1S_0–2^3P_0 possibly observed, under conditions yielding the highest electronic temperatures but not otherwise. To explain the observed limitation upon degree of ionization, a hypothesis involving recombination of ion and electron with conservation of electrical energy is brought forward.

Author.

1896. Rectification in discharge tubes. II. V. T. Chiplonkar. *Proc. Indian Acad. Sci.*, *A*, **13,** *pp.* 323–338, *May*, 1941.—Using the same method of observation as reported previously [Abstr. 568 (1940)] a detailed study has been made of the pressure variation of the rectification ratio, ρ, in discharge tubes, as a function of the relative sizes of the electrodes, σ, and the inter-electrode distance, l, in the case of air, hydrogen and nitrogen. For a given gas there exists a characteristic pressure for which the rectification is a max. Both the position and value of the max. depend on σ. Variation of l appreciably affects only the value of the max. rectification but not its position. The max. rectification is in general greater for smaller values of l. For higher pressures ρ shows a simple dependence on l, higher values of l corresponding to lower values for ρ.

Author.

1897. Probe measurements in gas discharges. G. Mierdel. *Arch. techn. Messen*, *No.* 105, *V*31–7, *March*, 1940. *In German.*—A progress review of theory and methods [Abstr. 764 (1927)]. In a plasma, i.e. a highly ionized gas in which carriers of positive and negative charges are present in equal densities, all quantities characterizing the discharge, e.g. electron speed, carrier density and temperature, space and contact potential, may be computed from the probe characteristic. The ideal probe characteristic is described and formulae for the computations are given for plane, cylindrical and spherical probes. The sources of error are discussed and a Bibliography is given. R. N.

***1898. Simple amplifier for small current pulses.** W. Riezler. *Z. techn. Phys.*, **21,** 11, *p.* 241, 1940. *In German.*—A vacuum tube circuit is described for the amplification and recording of pulses produced in a chamber by ionizing particles. Contrary to the usual arrangement the present one is especially designed for very small intensities, not exceeding 300 pulses/hr. This allows the use of a galvanometer of period 1 sec., which makes the instrument insensitive to disturbances such as building vibrations. Three stages of amplification are used, the first of which uses a space-charge grid tube, the others using triodes. The stability of the instrument is such that a max. sensitivity of 5×10^{-16} coulombs is obtained. G. H. D.

***1899. Geiger-Müller counters.** C. G. Montgomery and D. D. Montgomery. *J. Franklin Inst.*, **231,** *pp.* 447–467, *May, and pp.* 509–545, *June*, 1941.—A review of the construction, properties and applications, of various types of counters is given. The construction of counters is described in detail. A Bibliography of literature dealing with circuits for use with Geiger-Müller counters is given. A. J. M.

See also Abstract 1807.

CONDUCTION IN SOLIDS AND LIQUIDS.

1900. Investigations into the temperature dependence of electrical resistance and into the question of the validity of Mathiessen's rule. A new kind of change of electrical resistance of an isotropic electron gas in a transversal magnetic field. M. Kohler. *Ann. Phys., Lpz.*, **38,** 4, *pp.* 283–292, 1940. *In German.*—The electrical resistance of an isotropic electron gas in very strong transverse magnetic fields is calculated. At very low temperatures and at high temperatures the resistance is identical with that computed in the absence of a magnetic field to the first order of approximation. At intermediate temperatures the relation is shown to hold exactly for the limiting value of ρ in very strong magnetic fields and the conclusion is drawn that it cannot represent the ordinary resistance in this temperature range, as has been suggested. For isotropic conductors which possess residual temperature-independent resistance it is shown that the total resistance in strong magnetic fields is in agreement with the Mathiessen rule of additivity. M. S. V.

1901. Weber's theory of the kernleiter. A. M. Weinberg. *Bull. Math. Biophys.*, **3**, *pp.* 39–55, *June*, 1941.—The potential distribution about a kernleiter is determined according to Weber's method. It is shown that the distribution reduces to the solution of a telegrapher's equation when the volume of the external medium is small. The velocity of propagation as a function of the external volume is determined approximately. This involves the solution of the equation

$$[Y_0(k\xi)]'/[J_0(k\xi)]' = [\xi^{-a}Y_0(\xi)]'/[\xi^{-a}J_0(\xi)]'$$

where Y_0 and J_0 are Bessel functions, and roots of this equation are tabulated. The velocities thus found reduce to Lillie's values determined experimentally on the iron wire when the conducting medium is small. Deviations from these values are predicted for larger volumes. Author.

1902. Absorption measurements on colloidal solutions and electrolytes in the wavelength range between 10·5 and 20 m. J. Heffels. *Ann. Phys., Lpz.*, **37**, 7, *pp.* 477–494, 1940. *In German.*—The increase of conductivity at h.f. is measured by means of Malsh's method of the electrolytic thermometer for the following solutions: lecithine in benzol; cetylpyridine chloride in glycerine, glycerine plus 10% water and glycol; $MgSO_4$ in glycol and urea in water and glycerine. The range of wavelength was from 20 to 10·5 m. The Debye-Falkenhagen effect, as well as the theory of simple dipoles, appears insufficient to account for the experimental results. An attempt is made to explain them by assuming a structure for the solutions. M. S. V.

1903. Measurement of the conductivity and dielectric constant of biological media in the wavelength range between 400 and 10 000 m. R. Stachowiack. *Ann. Phys., Lpz.*, **37**, 7, *pp.* 495–507, 1940. *In German.*—The conductivity and dielectric constant of liver tissues in the range of wavelengths from 400 to 10 000 m. is measured. The resistivity ranges from 500 to 1 000 Ω/cm. cube while the dielectric constant goes as high as 16 000 for $\lambda = 10 000$ m. M. S. V.

See also Abstracts 1699, 1861.

DIELECTRICS AND CAPACITANCE.

1904. Local dielectric constant and solute activity. A hydration-association model for strong electrolytes. H. S. Frank. *J. Amer. Chem. Soc.*, **63**, *pp.* 1789–1799, *July*, 1941.—A new derivation is given for the Debye-Pauling expression for the effect of local dielectric constant on the electrostatic free energy of a central ion due to its ion cloud. If the local dielectric constant is less than 25, and if the ions can approach each other to distances equal to their crystal radius sums, the complete Debye-Pauling expression predicts large negative deviations from the Debye-Hückel limiting law for activity coefficients even in very dilute solution. This prediction is in disagreement with experiment. Agreement can be obtained by assuming that the ions in aqueous solution are hydrated and that they take part in an association equilibrium. [See Abstr. 420 (1941)]. Author.

See also Abstracts 1686, 1903.

ELECTROCHEMISTRY.

1905. Studies on lead oxides. III. The radioactive indicator method applied to the lead storage cell. IV. Polymorphic transitions by grinding, distortion and catalytic activity, in PbO. V. Further experiments on compounds of the type PbO $n(n = 1$ to 2). G. L. Clark and R. Rowan. *J. Amer. Chem. Soc.*, **63**, *pp.* 1299–1310, *May*, 1941.—The problem of the migration of ions in the lead/acid storage cell was studied by means of the radioactive indicator method. No migration was detected, either from positive to negative, from negative to positive, or from one part of a plate to another part of the same plate through the electrolyte. The conclusion is in accord with the Gladstone-Tribe theory of double sulphation, and it is unfavourable to the LeBlanc theory which states that the positive plate reaction takes place with the formation of plumbic ions as an intermediate product.—Subjecting metastable, yellow orthorhombic PbO to grinding converts it to a distorted red tetragonal PbO, as is evidenced by the characteristic broadening of certain lines and the decrease in intensity of high-order interferences on the X-ray diffraction pattern, as well as by the increased catalytic activity of the product. A quantitative study was made to correlate extent of grinding with degree of distortion, using the rate of decomposition of H_2O_2 as a measure of catalytic activity. In general, increased grinding up to 10 hrs. produces an increase in distortion. Distortion in PbO can be relieved completely by annealing. This process is rapid at 400° and 500°, slow at 300°, and apparently almost zero at 215°C. Attempts to relieve distortion by subjecting samples to liquid-air temperatures and to ultrasonic vibrations were unsuccessful. The fact that distortion in PbO can be removed by annealing lends further support to the theory advanced by Clark and Tyler, which states that the properties observed must be due to imperfectly crystallized areas as a result of the transition from orthorhombic to tetragonal arrangement which is still in process.—The lead oxide phase first described by LeBlanc and Eberius, to which they assigned the formula Pb_3O_4 and called black red lead, was prepared and studied. A comparison was made between the black red lead and Pb_5O_8 and Pb_2O_3. AUTHORS.

1906. Silver coatings on non-metallic surfaces. J. R. I. HEPBURN. *J. Electrodepos. Techn. Soc.* **17,** *pp.* 1–10, 1941.—The process of silvering by immersion can be carried out on non-metallic surfaces other than glass, including mica, celluloid, and plastic materials generally, and this offers various advantages as an alternative to the use of graphite or bronze powder. Details are given on 3 formulae (cane sugar, formaldehyde, Rochelle salt) and on practical methods for such Ag depositions. The details include preparation (cleaning and priming) of the non-metallic surface for deposition, preparation of ammoniacal Ag solution, efficiency of the process and recovery of Ag, and thickness of Ag deposits. N. M. B.

1907. Electrochemical properties of mineral membranes. I. The estimation of potassium ion activities. C. E. MARSHALL AND W. E. BERGMAN. *J. Amer. Chem. Soc.*, **63,** *pp.* 1911–1916, *July*, 1941.—The detailed electrochemical behaviour toward K ions of apophyllite and montmorillonite membranes was investigated. Apophyllite membranes are difficult to prepare and show a variable behaviour with K. Montmorillonite membranes dried at 490° gave reproducible results with solutions of several K salts; and at concentrations below 0·1 *N*, estimations of K ion activities can be made with a precision within 5%. AUTHORS.

1908. Studies in hydrogen over-voltage at high current densities. III. Influence of oxygen. IV. Influence of concentration, anions, temperature and catalytic poisons. A. HICKLING AND F. W. SALT. *Trans. Faraday Soc.*, **37,** *pp.* 319–321, *June, and pp.* 333–339, *July*, 1941.—[See Abstr. 868 (1941)]. The influence of the presence of oxygen has been investigated, and it is shown, in agreement with limiting-current considerations, that it may be without effect at high C.D.'s, although it causes a complete disappearance of over-voltage at low C.D.'s; at a critical C.D. the transition occurs abruptly. The conclusion is reached that for unstirred aqueous solutions the presence of oxygen is without appreciable influence at C.D.'s equal to or greater than 10^{-3} A/cm.^{2}, provided sufficient time has elapsed for the diffusion layer to be set up.—Variation of the concentration of acid and the use of different acids has little influence upon over-voltage except when conditions are such that concentration polarization occurs; this becomes appreciable in 0·1 *N*-solutions of strong acids at current densities greater than 10^{-1} A/cm.^{2} Rise of temperature to 70° causes a substantial diminution in over-voltage at Sn and Hg electrodes corresponding to an average temperature coefficient of approx. − 0·002 V/deg.; at W only a slight decrease occurs, and at platinized Pt no appreciable change could be detected. The addition of small quantities of As_2O_3, $HgCl_2$ and CS_2, raises the over-voltage at platinized Pt very considerably; the slope of the over-voltage/log C.D. graph is also increased, and in certain cases deviations from linearity are observed. Further measurements have been made at a W electrode. AUTHORS.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

1909. A linear theory of the electron. F. BOPP. *Ann. Phys., Lpz.*, **38,** 5, *pp.* 345–384, 1940. *In German.*—An attempt to build up a theory of the electron from the standpoint of Mie's theory and Born's singularities, satisfying the requirements of Lorentz invariance, linearity, finite energy and field everywhere, including the point electron. It differs from Mie's theory in that it is gauge-invariant, and from Born's in that it is linear. The electron is defined by a δ-function, satisfying the equation of continuity. The field is derived as usual from the potential by taking the *curl* (in 4 dimensions) and the field equations are derived from a least-action function in which 2 terms, one $s_\alpha\phi^\alpha$ and another, quadratic in the first derivatives of the field, are added to the classical term involving the energy density. A new universal constant λ_0, having the dimension of length, has to be introduced from dimensional considerations. It is only for field strengths which vary appreciably within the length λ_0, or within the time λ_0/c, that there is any difference with respect to Maxwell's field. This new field can be split up additively into 2 components: a Maxwell field and a Proca-Yukawa field for a neutral mesotron. Both fields have the same source, as opposed to Yukawa's theory where heavy particles are the sources of the field. The equations of motion are found from the requirement that energy and momentum are located in the whole field (not at the singularity), i.e. the Lorentz force of Mie's field, which can be split off because of the linearity, vanishes at the singularity. The quantum-theoretical side of the new field is approached and its discussion reserved for a forthcoming paper. M. S. V.

1910. Metal electrons in the gravitational field of the earth. F. Wolf. *Ann. Phys., Lpz.*, **38,** 5, *pp.* 385–398, 1940. Phys. Z., **41,** pp. 573–575, Dec. 15, 1940. *In German.*—The influence of gravity on the conduction electrons in a metal is investigated; the effects turn out to be extremely small; in the vertical direction there is a field $5{\cdot}58 \times 10^{-11}$ V/cm., independent of the kind of metal, and on the lower side a charge density of $3{\cdot}08 \times 10^{-7}$ electrons/cm.^{2} M. S. V.

1911. Rest mass of the mesotron. P. Weisz. *Phys. Rev.*, **59,** *pp.* 845–849, *June* 1, 1941.—Experimentally found values for the lifetime at rest of the cosmic-ray mesotron are directly compared after recalculating them on the basis of the same assumed rest mass. The corrected values still disagree but are shown to be a function of the average path length of the radiation employed in each experiment. When, instead of the existence of only 1 possible value for the rest mass for which we have no experimental evidence, a distribution in rest masses is assumed, the described phenomenon can be accounted for regardless of what form the mass distribution may have. The same assumption leads to explanations of other experimental findings, and predicts an actual lifetime much smaller than any measured value, strongly indicating that, upon correcting the measured results on the basis of the existence of a mass distribution, a value of the order of Yukawa's original prediction is obtained. Author.

1912. Lifetime of free electrons in Hg vapour. R. Grübling. *Ann. Phys., Lpz.*, **37,** 5–6, *pp.* 453–469, 1940. *In German.*—Waves of 3 cm. wavelength are produced by a Hertzian oscillator. They pass through a Hg discharge tube and their intensity is then measured with a bolometer. The absorption of these waves in the Hg vapour is measured as a function of the time after the discharge current is turned off (for times of 1×10^{-3} to 25×10^{-3} sec.). The decreasing absorption is shown not to be due to the diffusion of the plasma electrons out of the discharge, but is explained as due to their recombination. M. S. V.

1913. Influence of temperature on the secondary electron emission of metals. W. Reichelt. *Ann. Phys., Lpz.*, **38,** 4, *pp.* 293–303, 1940. *In German.*—A method is developed to determine the dependence of the velocity of secondary rays on the temperature of a metal at high temperatures, in which the influence of the thermal emission of the irradiated metal on the measurement is excluded. Tungsten was used, the temperature range was between 20° and 1 500°C., the primary velocity about 400 V. The secondary emission increases with increasing temperature, while the faster reflected primary electrons are practically unchanged. The temperature dependence is traced first to the energy increase of the electrons and to gas in the tube. M. S. V.

1914. Effect of temperature on the secondary electron emission of metals. R. Kollath. *Ann. Phys., Lpz.*, **39,** 1, *pp.* 19–22, *Jan.*, 1941. *In German.*—Discusses Reichelt's work on the velocity distribution of the secondary electrons of a metal at temperatures at which a considerable glow electron emission occurs, and particularly his main result of a much greater rise in the thermal energy of the secondary electrons than for the glow electrons with constant electron emission, a result, if substantiated, of far-reaching importance in the representation of the mechanism of this emission, to which A. Becker [*ibid.*, *pp.* 23–24] replies. H. G. S.

1915. Angular dependence of the secondary electron emission from insulators. H. Salow. *Phys. Z.*, **41,** *pp.* 434–442, 1940. *In German.*—The dependence of the secondary electron emission from mica, glass and ZnS, upon the angle of incidence of the primary electrons was measured by means of a previously described a.c. method [Abstr. 2520 (1940)]. The trend of the secondary emission was smooth between the angles of incidence 0° to 70° and between the potentials 100 and 4000 V. The secondary emission follows the same laws as those for metals. Assuming the validity of the Thomson-Widdington relation for the energy loss of the primary electrons, and an absorption of the secondary electrons proportional to their path lengths, a formula was derived which represents the results of the experiments with regard to the dependence upon angle and potential. The sudden changes in secondary emission [Abstr. 2469 (1928), 2245, 5067 (1937)] at certain angles was ascribed to their special method of measurement. The effect sets in when the secondary emission factor reaches the value unity and must not be regarded as a sudden change of the secondary emission. W. W. W.

1916. Quantum-yield of the bleaching of the *F*-band in alkali-halide crystals. H. Pick. *Ann. Phys., Lpz.*, **37,** 5–6, *pp.* 421–428, 1940. *In German.*—The optical transfer of electrons from the *F′*-into the *F*-state has been measured quantitatively as a function of temperature. It shows a trend opposite to the *F-F′* transfer; the yield increases with decreasing temperature and reaches the value 2 in KCl at − 200°C., that is, two *F′*-centres disappear at this temperature for every light quantum absorbed. The situation does not change for lower temperatures down to − 268°C., indicating that for this process no heat vibration of the lattice is required. A. von H.

1917. H.v. ultramicroscopy. E. Kinder. *Z. techn. Phys.*, **21,** 10, *p.* 222, 1940. *In German.*—The questions of object penetrability at various electron voltages, and of contrast available on the finished prints, are investigated with a magnetic electron microscope. Electron voltages ranged from 30 to 110 kV, exposure times from 2 to 10 sec. The objects used in the investigation include bacteria and insect wings. There is a range of object thickness in which greater contrast may be obtained by longer exposure at l.v. The paper is illustrated by a number of interesting microphotographs. G. H. D.

1918. Phase focusing in rectilinear electron beams. F. Borgniss and E. Ledinegg. *Z. techn. Phys.*, **21**, 11, *pp.* 256–261, 1940. *In German.*—The motion of electrons in the klystron is treated graphically and analytically. The flight of an electron departing from the modulator at a given instant is represented by a straight line on a distance/time plot. The intersection of 2 such lines, or the point at which one electron overtakes an earlier departing but slightly slower electron, is spoken of as the focus of the first order. The position of such a focus is a function of departure time, and a point where it becomes stationary, or a cusp in the envelope of paths, is known as a focus of second order. The existence of a focus of second order is assured, but the existence of a focus of higher order demands a very special dependence of the modulating voltage on the time, or else the use of more than 1 modulator. Conditions for the existence of a focus of higher order, and the variation of the density along the path, are given. Special attention is given to the case of purely sinusoidal modulations, and it is shown that no focus of higher order is obtained by the use of 2 modulators in the limit of very weak modulation. G. H. D.

1919. Investigation of properties of proportional counters. I. M. E. Rose and S. A. Korff. *Phys. Rev.*, **59**, *pp.* 850–859, *June* 1, 1941.—On the basis of a discharge mechanism in which the amplification is due to electron avalanches the theory of proportional counters is developed with the following primary assumptions: (1) All secondaries are produced by electron impact with no photon emission in the counter gas and thus no photo-electric emission at the cathode. (2) Fluctuations in energy loss and specific ionization are neglected. The gas fillers used in the measurements of the amplification factor were, for the most part, methane-argon mixtures; in addition, other polyatomic mixtures, e.g. illuminating gas, BF_3-A and ether-A were used. Comparison of theory and experiment gives quite satisfactory agreement in all cases but two. In the anomalous cases the measured amplification factor rises extremely rapidly, and such mixtures are therefore somewhat undesirable for stability reasons. This unstable behaviour is characteristic of gas mixtures of the monatomic and/or diatomic type. An explanation of the difference in amplification properties of the polyatomic and simpler type gases is proposed. It is shown that while photon emission in the ultra-violet and subsequent contributions to the avalanche by photo-electric emission at the cathode is to be expected for the simpler gases, polyatomic gases should effectively quench such photon emission by virtue of greater energy loss of the slower electrons in exciting molecular vibrations and rotations. Moreover, appreciable emission of ultra-violet light by polyatomic molecules under electron bombardment is not to be expected. This explanation receives confirmation from experimental tests. Authors.

1920. Electronic spectra of polyatomic molecules. H. Sponer and E. Teller. *Rev. Mod. Phys.*, **13**, *pp.* 75–170, *April*, 1941.

See also Abstract 1701.

ELECTROSTATICS.

1921. Electrostatic problems of 2 equal parallel circular plates. Y. Nomura. *Proc. Phys.-Math. Soc., Japan*, **23**, *pp.* 168–180, *March*, 1941.—The potential due to 2 equal parallel circular plates when the potential is specified over them is expressed as a series of integrals involving Bessel functions. Equations for the coefficients are found in terms of the boundary values and the solutions of these are determined numerically by iteration. Tables of these constants are given in the case of conducting plates. The capacitance of the plate condenser and the forces between 2 charged plates are calculated and these are plotted in curves against the distance between two plates. Author.

MAGNETISM AND ELECTROMAGNETISM.

1922. Modified electromagnetic energy-tensor. J. L. Synge. *Trans. Roy. Soc. Can., Sect. III*, **34**, *pp.* 1–27, *May*, 1940.—The electromagnetic energy-tensor is modified by omitting the self-energy terms, every electromagnetic field therefore being regarded as produced by electric charges. The equations of motion of a charged particle are deduced, the law of conservation being accepted. The total energy and momentum of a system and the flux at infinity are studied in detail. The momentum and energy of a system of 2 particles is considered and the total energy is shown, under suitable conditions, to contain a term which is the usual expression for the Coulomb potential energy. G. C. McV.

1923. Elementary processes of magnetization in the region of initial susceptibility. G. Thiessen. *Ann. Phys., Lpz.*, **38**, 2, *pp.* 153–175, 1940. ***Errata***, *ibid.*, **39**, 1, *p.* 30, *Jan.*, 1941. *In German.*—

On the assumption of high internal stresses, the relation is derived between the relative change of electric resistance $\Delta w/w$ and the initial susceptibility X_a for tension σ, also the relation between X_a and σ. By means of measurements of X_a $d(\Delta w/w)/d\sigma$, $dX_a/d\sigma$ and $dI_r/d\sigma$ (I_r, remanent magnetization) up to the Curie point, an experimental test of Becker's theory is carried through. At room temperatures the author finds complete agreement. At higher temperatures there are discrepancies which can be interpreted on the assumption that, in addition to rotations, there are increasingly larger perturbations. M. S. V.

1924. Theory of torque in a magnetic field of polycrystalline rolled iron plates. H. Mussman and H. Schlechtweg. *Ann. Phys., Lpz.*, **38**, 3, *p.* 215, 1940. *In German.*—The theory of Bitter and of Tarasov [Abstr. 1789 (1938)] on the effect which rolling has on the magnetic property of iron plates has been given further consideration. The partition function for the orientation of single crystals in the plate is discussed, and it is shown that the magnetic torque arising from the polycrystalline iron is expressed only by $\sin^2$ and $\sin^4$ terms concerning the angle between the field and rolling direction. This theory gives the possibility of a quantitative check on the X-ray data of crystalline orientation. M. S. V.

1925. Influence of internal stresses on the law of approach to saturation for Ni. R. Becker and H. Polley. *Ann. Phys., Lpz.*, **37**, 7, *p.* 534, 1940. *In German.*—Initial susceptibility and differential susceptibility in fields up to 1 100 oersted were measured on a sample of cold worked Ni. The measurements were repeated a number of times on the same sample after it had been successively annealed at different temperatures to relieve the strains gradually. The high-field measurements could be represented by the equation $dI/dH = A/H^3 + B/H^2$ in which, according to theory, A is supposed to be a function of the crystalline anisotropy and the internal strain. B is a purely empirical constant of unknown significance. The results show not only that A changes as the strain is reduced but also that B varies in a similar manner. A relationship between the constant A and the initial susceptibility is deduced, using Kersten's formula for the latter quantity and assuming randomly distributed stresses. The experimental data show that the form of this equation is correct, for large strains at least, and the quantitative agreement is fairly satisfactory. M. S. V.

1926. Passage of neutrons through ferromagnets. O. Halpern and T. Holstein. *Phys. Rev.*, **59**, *pp.* 960–981, *June* 15, 1941.—After setting up general equations for the behaviour of the neutron spin in different types of magnetic fields which correspond approx. to various stages of magnetization in ferro-magnets general results for the depolarization of an originally polarized beam are obtained. The possibilities of investigating the domain structure of ferromagnets by means of experiments with partially polarized neutron beams is discussed. Formulae for the change of intensity and polarization of a neutron beam traversing a saturated or quasi-saturated ferromagnetic medium are obtained. Authors.

1927. Passage of neutrons through crystals and polycrystals. O. Halpern, M. Hamermesh and M. H. Johnson. *Phys. Rev.*, **59**, *pp.* 981–996, *June* 15, 1941.—While the procedure is in many respects closely similar to that followed in the theory of X-rays, important and quantitatively decisive differences arise from the complicated coherence properties of the atomic scattering. The theoretical formulae developed permit interpretation in a quantitative manner as of experiments which show deviations from the additivity of nuclear cross sections. The Larmor precession of the spin of the neutron passing through the magnetized medium, and the well-known differentiation between the action of the vectors B and H can be explained as a simple dispersion phenomenon. The transmission and polarization of neutron beams passing through ferromagnetic bodies are determined. Authors.

1928. Magnetostriction, Young's modulus and damping of 68 permalloy as dependent on magnetization and heat treatment. H. J. Williams, R. M. Bozorth and H. Christensen. *Phys. Rev.*, **59**, *pp.* 1005–1012, *June* 15, 1941.—The magnetostriction varied with heat treatment from $2{\cdot}5\times10^{-6}$ to 22×10^{-6}. The change in Young's modulus with magnetization to saturation varied from 0·09 to 10·5%. Young's modulus and the damping constant were determined by measuring the natural frequency of vibration and the width of the resonance curve of a hollow rectangle magnetized parallel to its sides so that the magnetic circuit was complete without air gaps or end effects. *See also* Abstract 1699. Authors.

MEDICAL RADIOLOGY AND ELECTROLOGY.

1929. Contribution to the location of foreign bodies. R. J. Gilbert and H. U. Hertenstein. *Amer. J. Roentgenol. and Radium Ther.*, **45**, *pp.* 768–773, *May*, 1941.—Most U.S.A. X-ray apparatus has a coupled X-ray screen and tube, which does not permit relative movement and use of the usual location methods to determine the depth of foreign bodies. By use and extension of the Strohl locating cone method, direct measurements may be made on a scale which is described.

After discussion of the related geometrical principles suitable apparatus for Army work (as used in the French Army) is illustrated. The method is applicable to all types of X-ray couches. B. J. L.

1930. Explosion and fire hazard of anaesthetics in the presence of roentgenologic apparatus. B. A. Greene. *Amer. J. Roentgenol. and Radium Ther.*, **45**, *pp.* 737–743, *May*, 1941.—Explosions and fires have been caused by X-ray apparatus when used during the administration of anaesthetics. Sources of sparks which may occur in an X-ray room are considered and requirements for elimination of the dangers are specified. An apparatus which is shock-proof is not necessarily spark-proof. The use of non-combustible anaesthetics in an X-ray room, as local and intra-spinal injected anaesthetics, is advocated. B. J. L.

1931. Radium beam therapy. I. I. Kaplan. *Amer. J. Roentgenol. and Radium Ther.*, **45**, *pp.* 683–691, *May*, 1941.—Although the paper partly deals with clinical results of radium therapy, a description is given of a tube stand for the application of the large amount of 5 g. of radium in clinical work, together with details of construction. When not in use, or when the applicator is being adjusted to the patient's requirements, the radium is electrically removed from the applicator, and, after the operator is protected by a heavy lead screen, is automatically returned to the applicator, with arrangements for automatic removal at the expiration of any given time, so obviating the risk of over-exposure due to oversight of the operator. B. J. L.

1932. The progress of radium since its earliest therapeutic availability. A. Soiland. *Amer. J. Roentgenol. and Radium Ther.*, **45**, *pp.* 676–682, *May*, 1941.—The author describes a simple apparatus which allows the production of photographic film exposures which give a moderately accurate comparison of the distribution and depth dosage in phantoms analogous to human tissue, for small and large amounts of radium and 100 and 200 kV X-rays. Whilst the value of radium is not undervalued, these photographs suggest that, for attacking lower levels of the body, short-wave X-rays have certain advantages over teleradium. Application of both methods of treatment has provided a new and revolutionary agent to combat malignant disease. B. J. L.

PHOTO-ELECTRICITY.

1933. Electron emission of metals in electric fields. II. Field dependence of the surface photo-effect. E. Guth and C. J. Mullin. *Phys. Rev.*, **59**, *pp.* 867–873, *June*, 1941.—The photo-electric current emitted under the influence of an applied electric field is found to contain a term analogous to the Schottky term for thermionic emission and also a term periodic in the field intensity similar to that recently found and explained for thermionic emission. If frequencies near the threshold are used, then for fields of 3×10^5 V/cm. the periodic term has a magnitude of about 4% of the non-periodic part of the current. If the photo-electric threshold frequency for zero field is used to eject the electrons, the resultant plot of the non-periodic part of the photocurrent against the field is a straight line for high field intensities. This line gives the most convenient reference system for observing the periodic term; in addition, the use of the zero field threshold gives the fractional magnitude of the periodic term a relatively large value. [See Abstr. 1354 (1941)].

1934. Photo-electric properties of solutions of Na in liquid NH_3. J. Häsing. *Ann. Phys., Lpz.*, 37, 7, *pp.* 509–533, 1940. *In German.*—The external photo-electric effect of solutions of Na in NH_3 was measured with monochromatic light of wavelengths between 773 and 870 mμ. The work function was found to vary from 1·6 to 1·42 eV. The quantum yields and work functions show, when the measurements on concentrated solutions (over 1% Na) are compared with those on the pure metal, that it is a surface effect due to free electrons. For dilute solutions, on the other hand, the results indicate a volume effect due to bound electrons inside the solution. M. S. V.

THERMIONICS.

1935. Thermodynamic interpretation of certain thermionic and thermo-electric phenomena. C. Herring. *Phys. Rev.*, **59**, *pp.* 889–896, *June*, 1941.—It is well known that steady-state thermionic phenomena can be described only approximately in terms of the thermodynamic functions of equilibrium states of the metal concerned. These phenomena can, however, be related to the thermo-electric properties of the metal, and this relationship is developed for a metal of arbitrary crystalline symmetry. Application is made to the interpretation of experiments which measure the contact p.d. between metal surfaces at different temperatures, and to experiments which measure the cooling effect accompanying thermionic emission. In spite of the high accuracy with which measurements of the latter type can be made, it is not possible at present to draw conclusions from them concerning the temperature coefficient of the work function. This would be true even for a single crystal surface because of the uncertainty in the value of the Thomson coefficient at high temperatures; for polycrystalline surfaces an equal or greater uncertainty is introduced by patch effects. Author.